DESIGN / PLANNING PRINCIPLES & CONSTRUCTION GUIDELINES

FOR

MEMPHIS-SHELBY COUNTY SCHOOLS

Department of Major Construction
1364 Farmville Road
Memphis, Tennessee 38122

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SECTION I - INTRODUCTION

These Guidelines have been developed to assist Architects and Engineers in the planning and design of functional, cost effective and durable educational facilities that are attractive and enhance the educational experience for their students. Designers are encouraged to develop the design in a straightforward manner by utilizing standard building materials and details with a minimum of applied ornamentation and special treatments. Highest priority should be placed on the development of the interior learning environment with full attention given to the development of appropriate infrastructure, appurtenances, accessories, etc.

The Guidelines are not intended to limit or control opportunities for innovative design, but rather to assist the Designers in understanding certain planning requirements, design criteria, and concerns regarding construction and operation of Memphis-Shelby County Schools. Whenever the design of facilities varies significantly from the requirements and considerations of the Guidelines, the Designer shall obtain prior approval from the Director of Construction.

Additional and separate pre-design guidelines listing detailed space, programming, and equipment requirements will be issued for each construction project. ***In the event of any conflict between previous Guidelines and this Revised Guideline, the latest dated Guideline shall supersede the requirements of the previous Guidelines.*** Any current adopted code requirements shall supersede all of these requirements.

The Major Construction process will be strengthened and made less complicated if designers use these Guidelines at each phase of the project. It should be understood that these Guidelines will continue to evolve, and your comments and recommendations are invited for consideration in future revisions.

It is the desire of Shelby County Public Schools that the designs of its new school buildings and renovations incorporate certain characteristics. The following constitute our goals for good design:

- ***Sustainable Design:*** This applies to all building projects. It is Shelby County Schools' intent to approach each project to follow the basic LEED Design Qualifications to provide as many LEED points as practicable without going through the certification process.

- ***Economy of Space:*** The design should provide the programmed spaces in a configuration that minimizes the total area of the building, thus its cost. This means that circulation, mechanical, and service spaces shall be as efficiently arranged and configured as possible.

- ***Economy of Construction:*** It is MSCS's intent to construct buildings that will be usable and function as intended for fifty years or more. The design should use construction methods and techniques that are familiar and common in the local construction industry. Site work, footings, and structural systems should be chosen with efficiency and long-term durability in mind.

- ***Economy of Materials:*** The design should incorporate standard materials readily available in the local market at competitive prices. Long-lasting, easily cleaned and maintained materials and finishes should be chosen, even at a slight premium in cost if necessary.

- ***Economy of Design:*** The design should make use of the massing and arrangement of the elements of the building to achieve an attractive appearance. The use of extraneous and unnecessary design elements of high-cost materials to create a particular "look" or to "make a statement" is discouraged. The intent of the design should be timeless regarding appearance, finishes, and flexibility. The construction funds are much better spent procuring long-lasting materials. The coordination of all disciplines involved in the design process is crucial in order to obtain the most efficient and cost-effective configuration of materials and equipment in the finished building.

- ***Economy of Operation:*** All elements of the design, especially fire protection, mechanical, electrical, and plumbing systems, should be chosen for maximum lifetime, minimum maintenance, and cost-efficient operation.

- ***Planning for the Future:*** The design should, where and whenever possible, lend itself to future expansion; changes in technology or services; or rearrangement of spaces to meet changing educational or administrative needs.

In accomplishing the above, MSCS expects and requires the Designer:

- To follow and comply with each section of the Guidelines and all items included as APPENDIX A - PROCESS IMPROVEMENT CHECKLIST of the Design Guidelines.

- To have the planning team sign off on each design phase of the building after a full presentation explaining how it meets all criteria given in the program.

- To have all specialty stakeholders (Information Technology, Media Services, Library, Food Services, Vocational programs, Plant Operations and Maintenance, etc.) sign off on the final design of their areas, including basic furniture layouts, power and utility service locations and the MEP systems.

- To ensure that the design complies with all applicable Codes and Regulations of authorities having jurisdiction over the project. Specifically, included in this requirement is to have all reviewing agencies complete their reviews and for the Designer to address all comments resulting from those reviews in the bid documents. This shall not be accomplished as addenda.

- To coordinate with all utility services regarding requirements for the project, insuring all are available as needed. Where necessary, assist the Owner in whatever application processes are needed to obtain those services.

- To design the project to be accomplished within the Owner's designated budget. Where the Designer becomes aware that the project will require work outside of their responsibilities (such as sewer or water line construction off the project site), the Designer shall inform the Owner of whatever application processes are needed to obtain those services.

- To be diligent in the administration of the Contract during Construction. Reviews of shop drawings and other submittals within a reasonable schedule and immediate attention to problems and questions are considered important parts of services rendered. Ensuring that the quality of materials and workmanship incorporated into the work corresponds to that specified is important to the Owner. Diligent review and inspection of the HVAC System at Shop Drawing stage and during construction is extremely important to the owner.

  It is also extremely important that the Contractor have all the information required to complete the project. Claims for delays due to Architects' or Engineers' insufficient or incorrect information and non- responsiveness are not acceptable and will be cause for reimbursement to the Owner from the Architect or Engineer at fault. Any valid delays will be clearly established and substantiated; ambiguous or unclear.

A. Abbreviations

AABC	Associated Air Balance Council
ACT	Acoustical Ceiling Tile
ADA	American Disabilities Act
AE	Architect/ Engineer
AFF	Above Finished Floor
AHERA	Asbestos Hazard Emergency Response Act
AHJ	Authority Having Jurisdiction
AHU	Air Handling Unit
AMP	Ampere
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, & Air-conditioning Engineers
ASI	Architect's Supplemental Information
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
BACnet	Building Automation Controls Network
BAS	Building Automation System
BTU	British Thermal Unit
CCTV	Closed Circuit Television
CDR	Contingency Draw Request
CDX	C-D Exposure 1 plywood
CFC	Chlorofluorocarbon
CFM	Cubic Feet per Minute
CLS	Clinical Laboratory Standards
CM	Construction Manager
CMU	Concrete Masonry Unit
CNC	Central Nutrition Center
CO	Change Order
CPM	Critical Path Method
CRI	Carpet and Rug Institute
CSI	Construction Specification Institute
DEM	Digital Energy Monitor
DDC	Direct Digital Controls
DoMC	Department of Major Construction
ECM	Electronically Commutated Motors
EIFS	Exterior Insulation Finish System
EMS	Emergency Management Systems
EMT	Electrical Metallic Tubing
EPDM	Ethylene Propylene Diene Monomer
FCU	Fan Coil Unit
FFE	Furniture, Fixtures, & Equipment
FLCC	Fixed Limited Construction Cost
GC	General Contractor
GFI	Ground Fault Interrupter
GFCI	Ground Fault Circuit Interrupter
GPM	Gallons Per Minute
HVAC	Heating Ventilating, and Air Conditioning
IBC	International Building Code
IDF	Intermediate Distribution Frame
IEEE	Institute of Electrical & Electronics Engineers
IMC	Intermediate Metal Conduit
IP	Internet Protocol
ISEA	International Safety Equipment Association
IT	Information Technology
KAIC	Kilo Ampere Interrupting Capacity

LCD	Liquid Crystal Display
LED	Light Emitting Diode
LEED	Leadership in Energy & Environmental Design
LVT	Luxury Vinyl Tile
MLGW	Memphis Light Gas Water
MSCBOE	Memphis-Shelby County Board of Education
MSCS	Memphis-Shelby County Schools
MSI	**Master System Integrator**
MWSBE	Minority Women-Owned Small Business Enterprise
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NRC	Noise Reduction Coefficient
NSF	National Sanitation Foundation
OAC	Owner Architect Contractor
O&M	Operations & Maintenance
PM	Project Manager
PO	Purchase Order
PP-R	Polypropylene Random Copolymer
PSI	Pounds per Square Inch
PVC	Polyvinyl Chloride
RFP	Request for Proposal
RFI	Request for Information
RTU	Roof Top Unit
SEER	Seasonal Energy Efficiency Ratio
SMACNA	Sheet Metal & Air Conditioning Contractors' National Association
SOV	Schedule of Values
SCUV	Self- Contained Unit Ventilator
STC	Sound Transmission Class
TBI	Tennessee Bureau of Investigation
TPO	Thermoplastic Polyolefin
TSSAA	Tennessee Secondary School Athletic Association
UDC	Uniform Development Code
UL	Underwriter Laboratories
UV	Unit Ventilator
VCT	Vinyl Composition Tile
VFD	Variable Frequency Drive
VOC	Volatile Organic Compound
WAP	Wireless Access Point

SECTION II - PROJECT ADMINISTRATION

A. DEPARTMENT OF MAJOR CONSTRUCTION

1. Purpose

The Department of Major Construction is responsible for the administration of the Capital Improvements Program for Memphis-Shelby County Schools as well as other projects requiring detailed construction administration.

In this capacity, the department supervises the programming, design, construction, of new buildings, additions to existing buildings, and major renovations and repair/replacement projects.

2. Staff

NAME	TITLE/ POSITION	EMAIL ADDRESS
Chris Lafoy	**Director of Construction**	**lafoycj@scsk12.org**
Scott Steen	**Senior Project Manager**	**steensa@@scsk12.org**
Marc Calma	**Project Manager**	**calmamn@scsk12.org**
Parish Sharkey	**Project Manager**	**sharkeypl@scsk12.org**
William Rudolph	**Senior Project Manager**	**rudolphwc@scsk12.org**

3. Address

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Department of Major Construction
1364 Farmville Road
Memphis, TN 38122
Phone: 901-416-1675 | Fax: 901-416-6968

4. Mission Statement

The mission of the Department of Major Construction is to create and support a well-maintained district infrastructure and to provide the highest quality service in a responsive and efficient manner for all our customers and colleagues. We recognize our staff as our strength and will trust and respect each other while working together to support the overall mission of Memphis-Shelby County Schools.

5. Vision

- Exceed customers' expectations
- Encourage the culture of teamwork
- Ensure the appropriate application of operating, capital improvement, renovation, maintenance, repair, and utility resources.
- Be fiscally responsible
- Optimize management systems and technologies
- Be recognized nationally for excellence in facilities, environmental, and safety management.

6. ADA Compliance Statement

The Department of Major Construction shall ensure that all Shelby County facilities comply with the Americans with Disabilities Act. The Designers shall ensure that all projects comply with the current and adopted Americans with Disabilities Act including revisions and interpretations.

The Department of Major Construction request that the Designer include in the general notes an ADA Disclaimer or Non-discrimination Statement.

SECTION III – DUE DILIGENCE

A. Scope of Work

The Designer may be requested to assist in providing a detailed scope of work to include due diligence specifically related to the project site. This due diligence shall require but not be limited to the following:

1. Boundary, Topographical & Utility Site Survey
2. Tree Density Survey
3. Preliminary Geotechnical Report
4. Primary Geotechnical Exploration Report
5. Phase 1/ Environmental Assessment Study
6. Traffic Impact Study
7. Historical & Archeological Property Survey
8. Protected Species Assessment
9. Wetland Delineation, Assessment, & Consultation

SECTION IV – PROGRAMMING / EDUCATIONAL SPECIFICATIONS PHASE

A. Project Kickoff

The Architect shall meet with representatives from the Department of Major Construction to review and confirm the general goals, scope components, constraints and requirements of the project as set forth in the initial pre-design documents. If the project is an addition to and/or renovation of an existing school, the Architect shall be provided with the latest existing documents on file that may include but are not limited to:

- Fire Marshal's annual inspection reports
- Asbestos surveys
- Roof condition report
- Facility condition reports
- Construction documents- Plans, Specifications, Project Manual where available
- Supplementary Information- AHJ Applications, AHJ Comments, etc.

B. Program Confirmation/Transmittal

A programming session shall be held with the architect, Project Manager and others to determine if any "needs" and "priorities" have changed or need revising. This meeting shall cover the following topics:

1. Participants and points-of-contact in programming:
    a. MSCS Project Manager
    b. Architect
    c. Planning Team
    d. Program Manager
    e. Director of Major Construction
    f. Selected members of the school or other personnel, if determined

2. Confirm the following components as necessary:
    a. Number of classrooms
    b. Auxiliary spaces
    c. Relationship of spaces
    d. Space adjacencies
    e. Size of spaces
    f. Special considerations, programs, or classes requiring additional spaces
    g. Furniture and equipment
    h. Special equipment
    i. Future expansion possibilities
    j. LEED status, when applicable

3. Determine priorities of the components of the project to aid in scope and cost management of the project during design development.

C. Architect's Deliverables

1. Bubble diagrams of building components. (SWOT analysis)
2. Bubble diagrams of site relationships. (SWOT analysis)
3. Cost estimate for construction (per sq. ft.) (SD, DD, CD)
4. Project schedule with MSCS input regarding expectations and fiscal calendar. (SD, DD, CD)

D. Review

The above information shall be reviewed with the Project Manager and Planning Team at a review meeting. Written approval from the Project Manager will be required prior to the architect proceeding with the schematic design phase.

SECTION V - SCHEMATIC DESIGN PHASE

Designers shall develop and submit to MSCS conceptual diagrams of alternative approaches for translating the project requirements into conceptual design solutions. These diagrams shall include, but not limited to, consideration of land use, functional relationships within the program, consideration of relationships to Master Plans, and/or surrounding neighborhood environment, relative volumes of circulation, land use, traffic, parking, transportation, utilities, and systems and organization of major building functions.

Designers shall prepare and submit to MSCS visual studies related to the concepts required conceptual diagrams which shall include, but are not limited to, schematic massing studies in model and/or diagrammatic form, sketches of design concepts showing elevations and exterior appearances, and any other sketches or visual studies necessary for evaluation of several alternative concepts.

A. Architects Deliverables

The schematic deliverables shall include but not be limited to the following:

1. Schematic Site Plan.
2. Traffic pattern plan and neighborhood impact review
3. Schematic floor plans
4. Schematic elevations
5. Other drawings as needed to convey the design intent
6. Narrative description of architectural, structural and mechanical, plumbing, and electrical systems
7. Cost estimate per square foot costs updated from programming.
8. Compliance with Master Schedule or recovery schedule proposal
9. Review of input and comments from Zoning, Codes, Public Works, Shelby County Storm Water Division (ponds) and State and Shelby County Fire Marshals.
10. Review of Process Improvement Checklist. (With applicable items initialed by Architect)

B. Review

At the conclusion of Schematic Design, the Architect will meet with the Project Manager, User Groups and selected MSCS staff to present Schematic Design progress. The Schematic Design Documents will be reviewed by Owner as input is collected from other stakeholders on the team. A timeframe for this review shall be agreed upon by all parties.

C. Approval of Schematic Design

Written approval from the Project Manager will be required prior to the architect proceeding with the design development phase.

SECTION VI - DESIGN DEVELOPMENT PHASE

A. Architects Deliverables

Based on the approval of the Schematic Plans by the MSCS staff, the Architect shall completely design the components of the Project that include but are not limited to the following:

1. Site plans showing:
    a. Utilities (including fire protection provisions)
    b. Traffic pattern plan and neighborhood impact review
    c. Landscaping (designate code-required landscaping versus non-code required)
    d. Pedestrian flow
    e. Storm water management (conforming with Public Works Department requirements)
    f. Any Owner furnished items such as the Site Survey, Phase I site assessment, traffic impact studies, or other site information should be included to provide all site related information.
2. Floor plans with square footage calculations per programmed space and room numbers (room numbers to be coordinated with existing room numbers as appropriate for the project scope. Numbers shall be used for code required signage.)
3. Elevations and building sections
4. Roof system proposal
5. Net Area(s) calculations
6. Materials selections
7. Fire Protection System
8. Structural system
9. Electrical system layout
10. Mechanical system layout
11. Plumbing system layout
12. IT system layout (per MSCS Information Services Group requirements)
13. Low Voltage system layout
14. Kitchen plan and equipment description coordinated with MSCS Central Nutrition Center
15. Outline specifications and cut sheets for major equipment and fixtures
16. Massing model or computer model, if appropriate for the project (verify with PM).
17. Furniture layouts as coordinated by MSCS furniture preferred vendor
18. Finish Schedule and notes with finish board with labeled materials
19. Schedule Update with MSCS input (Including construction timeframe)
20. State and Shelby County Fire Marshal review status
21. Review of Owner's Process Improvement Checklist (Applicable items shall be initialed by Architect)
22. Detailed cost estimate to verify the FLCC for the remainder of the project.
23. Draft exterior architectural rendering
24. Engineering submittal to MLGW if required by project scope.
25. Submittal to Public Health if grease trap is part of the project's scope.

The Architect and Project Manager shall agree upon several milestone reviews of the design to ensure proper content and development.

B. Review

At the conclusion of Design Development Phase, the Architect will meet with the Project Manager, User Groups and selected MSCS staff to present Design Development progress. The Design Development Documents will be reviewed by Owner for time to be determined as input is collected from other stakeholders on his team.

C. Approval of Design Development

Written approval from the Project Manager will be required prior to the architect proceeding with the construction documents phase.

SECTION VII - CONSTRUCTION DOCUMENTS PHASE

A. Review

The Architect shall prepare and submit construction documents for formal review by the Project Manager at the 50% stage and 90% stage and shall incorporate or make an appropriate response to all Owner comments and/or requested revisions.

B. Project Manual

The Architect shall prepare the Project Manual according to the Design Guidelines and Process Improvement Checklist furnished by the Owner. Organize specifications in the current CSI format.

C. Regulatory Agencies

The Architect shall make submissions for all regulatory reviews, respond to all comments, and obtain approvals prior to bidding. The following information is given as a guide to help Architects and others to meet their contract requirements (*Article 1.7.2 of the Terms and Conditions of the Agreement between Owner and Designer*) of having a building permit ready prior to bid date. In order to prevent construction delay claims and change orders after bids are received, this process must be complete prior to the last addendum scheduled for issue. Do not submit plans to the Codes Department and wait for them to get to the review agencies; the Architect shall make direct submission to all relevant agencies and is advised to obtain the names, preferably the signatures, of the staff members receiving the documents. The drawings must be reviewed and approved as code compliant by the required agencies.

D. Payment of Fees

Required review fees to be paid by the designer and is a reimbursable expense under the Designer Agreement. Designer is requested to provide reimbursable fee estimate prior to executing contract.

E. Building Permit Procedures

Refer to www.shelbycountytn.gov and www.SCSk12.org for information pertaining to department contacts.

Permits must be obtained prior to any work performed, no matter the type of work.
When the submittals have been made, notify the MSCS Project Manager the submittals were made. Submittals to the State Fire Marshal and Shelby County Code Enforcement should be made as early as possible. Interim reviews of the design with the State Fire Marshal and Shelby County Code Enforcement during all phases are encouraged.

F. Required 50% / 90% Deliverables

1. 50% review – Documents required for the review include but are not limited to the following:
   a. 50% working drawings
   b. 50% specifications
   c. Agency Review (submittal verification)
   d. Schedule Update with MSCS input (Including construction timeframe)
   e. Review of Owner's Process Improvement Checklist. (All items to be initialed by Architect.)
   f. Verify that the project meets the FLCC
   g. LEED status where applicable

2. 90% Review Documents required for the review include but are not limited to the following:
   a. Complete working drawings
   b. Project manual
   c. Agency approvals - A building permit must be obtainable at this point.
   d. Schedule Update with MSCS input (Including construction timeframe)
   e. Full color tempera, acrylic or computer-generated rendering of the project, mounted and suitable for framing (unless project is small scope – see your PM for decision whether this is required).
   f. Fully completed Owner's Process Improvement Checklist
   g. Verify that the project meets the FLCC

3. The following issues should be discussed at the 100% review meeting.
4. Hard copy criteria for bid process- Available to bidders at their cost
    a. Bidding process
    b. Revisions to be implemented
    c. Pre-Bid conference date and bid date
    d. Contract award process

G. Division 1 Specifications, Including Invitation to Bid

Architect will request current version of MSCS Division 1 Specifications, including Invitation to Bid, to be incorporated into Project Manual. The designer shall become familiar with the front-end documents' provisions and ensure that other specification sections created by the design team do not conflict with them. Specifically, review all references to "equal" products and procedures for submitting substitutions for specified products.

SECTION VIII – BIDDING PHASE

A. Bid Policy

1. Design-Bid-Build (DBB)
2. Design-Build (DB)
3. CMAR (Construction Manager At Risk)
4. IPD (Integrated Project Delivery)
5. JOC (Job Order Contracting)
6. Multi-Prime (MP)
7. PPP (Public Private Partnership)

All project delivery methods must comply with MSCS standards.
The Architect, following the MSCS approval of the construction documents, shall assist the Procurement Department of Memphis-Shelby County Schools in obtaining sealed bids and in awarding a contract for the construction of the project.
The time and date for the receipt and opening of the sealed bids shall be determined by the MSCS Procurement Department and MSCS Director of Major Construction. Bids will be opened at the location as designated by MSCS Procurement Department.

The MSCS Procurement shall be responsible for the placement of a legal advertisement for bids. The Architect is requested to attend the Bid Opening and record results.

B. Document Distribution

1. Architect is responsible for coordinating the distribution of contract documents with interested bidders. At bidder's request, hard copies of the Bid Documents should be made available and ready for pick-up on the advertised date. The architect will record the recipient's contact information. No partial sets shall be issued.

2. Architects in coordination with MSCS Procurement Department shall be responsible for distributing to all bidders and / or holders of issued sets any addenda that are issued.
   a. No addendum shall be issued, without prior approval of DoMC and MSCS Procurement department. All addendums are required to be approved by the Department of Major Construction. The cutoff time for issuing addenda should be listed on the Invitation to Bid in the Project Manual.
   b. The addenda shall be sequentially numbered and dated. They shall also be signed and sealed by the Architect and appropriately approved by codes.
   c. The Architect shall prepare a notification to the Bidders for any documents available for review at the locations of the project documents.
   d. A bidders' log will be kept, recording date, person and company receiving the bid package.

C. Pre-Bid Conference

This conference is mandatory for all prime bidders. The date for this meeting shall be identified and published in the bid package. The issues in this meeting shall cover and not be limited to the following:

1. Delivery of complete bid packages.
2. Scope of work.
3. Document all changes in writing, verbal instructions are not binding.
4. Addenda.
5. Bid date and time.
6. Tour site if applicable.
7. Coordination of site access and any existing building involved in the work.
8. DBE Program requirements.
9. Wage rates for federally funded projects. (Do not include wage rates for Shelby County funded projects) Note: it is rare to have a federally funded project.
10. Review requirements in the Invitation to Bid.
11. TBI background check is required for all workers on school property.
12. Review LEED requirements.

D. Receiving Bids

MSCS Procurement Department in cooperation with the MSCS DoMC will determine when bids are to be received. This information shall be noted in the bid package. The following conditions shall govern the bid opening:

1. Bids received after the bid deadline will not be accepted for consideration and will not be opened.
2. No bids will be opened that do not bear the proper information on the bid envelope in accordance with the Instruction to the Bidders and current state law. All bidders must meet all the solicitations requirements and criteria for bids to be accepted.
3. Fully disclose envelopes that meet the above requirements, whether or not all required information inside is present or complete.
4. The Director of the DoMC in coordination with the MSCS Procurement Department, may waive certain formalities in the best interest of MSCS.

E. Conducting and Opening

The buyer/ representative of the Procurement Department shall receive, open and read aloud all bids submitted. The following information must be reviewed and recorded. The Architect as well as the Procurement buyer/ representative shall provide a bid tabulation sheet and record the bids as they are read aloud during the opening of a bid.

1. **Bid Envelope**
   a. SCBOE project name and number.
   b. Name of bidder and address.
   c. License number, expiration date, classification and limit.
   d. Listed subcontractors for geothermal heating and cooling, mechanical, electrical, plumbing and masonry trades in accordance with the Tennessee Code Annotated. Must have name, license number, date of expiration, and license classification listed. List additional subcontractors as required by MSCS.
   e. Contractors Federal ID number (tax number)
2. **Bid Form**
   a. Acknowledged Addenda.
   b. Bid Security/ Bid Bond/ Surety with proper signatures and Power of Attorney.
   c. Unit Prices and allowances.
   d. Base Bids and Alternate Prices.
   e. Presence of Insurance Affidavit
   f. Presence of any other required documents.
   g. Authorized signatures as required.

F. Disposition / Awarding of Bids

The Procurement Department buyer/ representative, Architect and MSCS DoMC representatives shall evaluate all bids to determine recommendation for award to the lowest responsive and responsible bidder. If the bid is in proper order and within budget, a contract preparation will begin after a Notice of Award Intent is issued. The contract draft will be signed by the successful bidder and presented to the Procurement Depart for recommendation for SCBOE approval and signature. If the bid is not in budget, the project will be evaluated with the design team, MSCS DoMC representatives, and Procurement department to determine if the project can be value engineered, modified, and negotiated with the low bidder.

MSCS exercises the right to select "best value" for the project with regards to schedule and financial impacts. These rights may result in the lowest bid not being selected due to a higher bid being more inclusive, including product longevity, and a more efficient project schedule.

SECTION IX – CONSTRUCTION ADMINISTRATION PHASE

A. Architect's Contract Obligation

The Architect is responsible for all components of Article 1.9 "Phase 6: Construction Phase" in the Terms and Conditions of the Agreement between Owner and Designer.

B. Administration

Architect is responsible for:

1. **Requests For Proposal (RFP):** Each RFP shall be written, recorded and reviewed by the Architect. Approval must be coordinated through the PM to perform the same. RFPs are not directives to proceed with any work. The Designer and PM are to maintain an RFP log which shall be distributed once a month and included with AE invoices for services. Architect and his consultants shall review and approve RFP/Proposal prior to submission to the PM and MSCS DoMC for approval.

2. **Request For Information (RFI):** The Architect shall respond to all requests for information, both formal and informal, in a timely manner. The Designer shall maintain an RFI log which shall be distributed once a month and included with AE invoices for services. The log shall include RFI number, date of issue, date of receipt, date of response, summarized requested information, and summarized formal response.

3. **Field Reports:** In accordance with the contract, the Architect shall provide to the Owner a minimum of two written field reports each month. Latest AE field report shall be attached to AE invoice for services. Field reports shall be detailed and provide information regarding schedule, current financial status, deficiencies, weather, etc. MSCS DoMC prefers to have photos attached to reports for visual confirmation. (See A/E Agreement)

4. **Contingency Draw Request (CDR):** The Architect shall not issue CDR's without prior approval from the MSCS PM and the Director of Major Construction. CDR's are funded by the Owner's contingency. The transfer of contingency funds to the contractor's purchase order (PO) can only be executed with a fully executed Contingency Draw Request form that has been signed by the contractor's representative, the AE representative, and the Department of Major Construction. The AE and MSCS PM will keep a CDR log and update as required. The CDR log will be submitted with the AE invoice for services.

5. **Change Orders:** Change orders will be prepared and issued by the AE and MSCS PM after receipt of approved RFP/Proposal that includes in depth detail and support documentation. The Designer is to maintain a COR log and shall be distributed once a month.

6. **Submittals:** As stated in the contract, the Architect shall be responsible for providing a design professional for the purpose of submittal review. Submittal review is critical as a final coordination check for proper inclusion of all building components. Submittals must be thoroughly checked by the designer to make sure that each component meets the intent and requirements of the specifications for the project and will work with the components in the assembly. Failure to do so will be cause for reimbursement to the Owner from the Architect or Engineer at fault should costs be incurred by the Owner in corrections. Submittals shall be reviewed and expedited in a timely manner, and recorded in a Submittal Log, maintained by the Architect and shall be distributed monthly. For roofing, door hardware, HVAC and plumbing submittals MSCS shall review for design intent. MSCS project manager will identify submittals required to be submitted simultaneously to them and the MSCS User Groups.

7. **Pre-Installation Conferences:** The Architect shall conduct pre-installation conferences and record meeting minutes for review by the MSCS PM. Architect shall distribute approved meeting minutes within five business days of the meeting. Pre-Installation conferences should be conducted, at a minimum, for the following: masonry/envelope mock-ups, roofing, windows, louvers, fire-caulking, flooring, spray-applied insulation, low-voltage, and Division 06 Casework.

8. **Progress Meeting (OAC):** The Architect shall conduct Progress Meetings at least twice a month and record meeting minutes for review by MSCS PM and Director of MC. Architect shall distribute approved meeting minutes within three to five business days of the meeting.

9. **Progress Payments**: The Architect shall review and approve contractor's monthly pay application and provide signatures as needed. Special attention should be given to percentage completed on line items of the schedule of values. Items shall be compared to the cost-loaded CPM schedule as provided by the Contractor prior to approval. Formal comments are required to be returned to the contractor for review, consideration, and response.

SECTION X - CLOSE-OUT PHASE

A. Substantial Completion

It is the Architect and MSCS Project Manager's responsibility to determine, after receiving written notification of such from the Contractor, whether or not substantial completion has been reached. Schedule an inspection at the earliest possible time to determine the status of completion. At this inspection, address the following issues:

1. Status of Schedule
2. Contractors Deficiency "Punch" List (Provided by Contractor)
3. Develop Punch List (by Architect)
4. Demonstration of Equipment and Systems
5. Discuss Substantial Completion Certification
6. Obtain Use and Occupancy permits from applicable regulatory agencies and schedule Final Inspection. Architect, Project Manager and Contractor shall all agree upon duration and date for completion of all outstanding items. The Bid Form (thus the Contract) includes a space to define the period following which damages shall apply. The Principal will be asked to review the punch list and suggest items to be included.
7. Commissioning
8. LEED Documentation, as applicable
9. Radon Testing, as applicable.
10. Training as required

B. Final Completion Inspection

Schedule Final inspection upon written notification that a qualified person authorized by the Contractor has reviewed the Contract Documents and Punch List(s), has inspected the work, and finds it complies with the Construction Documents and that all Punch List items are corrected. At this inspection, address the following issues:

1. Review of Contractors Deficiency List
2. Review of Punch List items
3. Discuss completion status
4. Submittal of O&M documents
5. Obtain final Use and Occupancy permits from applicable regulatory agencies.
6. Discuss damage/s
7. As-Built documents
8. Commissioning log

The punch list shall include all identified outstanding items provided by the Architect with input from the Project Manager and School Staff. This list shall include a completion date for all punch list items. The Contractor, Project Manager, Principal and Architect shall receive a copy of the punch list.

C. Warranty Inspection

A warranty inspection, attended by the principal and/or their designated School Staff, Maintenance Department, Architect, and Project Manager, shall be conducted near the end but prior to expiration of the one-year warranty period for the construction (11-month walkthrough). This inspection shall be for the purpose of determining if there are any unresolved issues that are covered by the contractor's warranty responsibilities and addressing their correction. Items suggested for the warranty inspection can be provided by the Principal, Staff, Maintenance Department, Architect or Project Manager.

SECTION XI - RECORD DOCUMENTS

A. Electronic Drawings

The Architect shall provide, at project closeout, a complete set of electronic documents (pdf format) that fully reflects all design revisions, change orders, field directives and Contractor's as-built markups without revision clouding. These documents shall be sent to the MSCS PM for storage in DoMC's archival file.

B. Record Set

When requested, the Architect is to provide MSCS PM one set of the above reproducible drawings in the size requested, half or full size. (See A above).

C. Small Scale Set

The Architect shall provide a small-scale set of site and floor plans for the building including graphic scale, scaled to fit the site plan and each floor level as large as possible on sheets 8-1/2" x 11" or 11"x17" in size as determined. Overall floor plans shall be to the same scale and positioned to superimpose upper and lower plans with the sheets stacked. The drawings shall have no dimensions or notes, but should include room numbers, and may be either single- or double-line wall representation, as appropriate, for the scale necessary to fit the plans on the specified sheet size. Site plans shall include all drives, walks, and athletic field layouts, but no landscaping. This set of drawings shall be sent to the MSCS PM during project close-out.

D. AutoCAD Deliverables

The Architect shall provide, at project closeout, DWG files of each record document sheet with all x-references bound.

DWG file of overall floor plans with all architectural elements showing, at a minimum, room names and numbers, walls, doors, casework, plumbing fixtures, etc. Exclude F.F.E. Notes, dimensions, and call- outs.

Provide Revit models if available.

E. Asbestos Statement

The architect shall provide, at project closeout, per the requirements of *DIVISION 02 26 23 – LEAD / ASBESTOS / HAZARDOUS MATERIALS*.

SECTION XII – DESIGN & CONSTRUCTION STANDARDS

A. Basis of Design

Unless otherwise noted in these standards, all manufacturers shall be listed as the preferred "Basis of Design". Where manufacturers are noted as "single source," no other manufacturers shall be allowed. A&E should confirm with MSCS PM that single source vendors are and have been approved by the MSCS Procurement Department as required per state procurement statutes.

DIVISION 00 00 00 - DEFINITIONS AND ABBREVIATIONS

1.1 DEFINITIONS & ABBREVIATIONS

A. A/E: Architect/Engineer

B. Acceptance Phase: Phase of construction after startup and initial checkout when Functional Performance Testing, O&M documentation review and training occurs.

C. Air Barrier Accessory: Products designated to maintain air tightness between air barrier materials, air barrier assemblies and air barrier components, to fasten them to the structure of the building, or both (e.g., sealants, tapes, backer rods, transition membranes, fasteners, strapping, primers).

D. Air Barrier Assembly: The combination of air barrier materials and air barrier accessories that are designated and designed within the environmental separator to act as a continuous barrier to the movement of air through the environmental separator.

E. Air Barrier Component: Pre-manufactured elements such as windows, doors, dampers, and service elements that are installed in the environmental separator.

F. Air Barrier Envelope: The combination of air barrier assemblies and air barrier components, connected by air barrier accessories that are designed to provide a continuous barrier to the movement of air through an environmental separator. There may be more than one air barrier envelope in a single building. Also known as Air Barrier System.

G. Air Barrier Material: A building material that is designed and constructed to provide the primary resistance to airflow through an air barrier assembly.

H. Air Leakage Rate: The rate of airflow (CFM) driven through a unit surface area (sq.ft.) of an assembly or system by a unit static pressure difference (Pa) across the assembly (example: 0.25 CFM/sq.ft. @ 75 Pa).

I. Air Leakage: The total airflow (CFM) driven through the air barrier system by a unit static pressure difference (Pa) across the air barrier envelope (example:6500 CFM @ 75 Pa).

J. Air Permeance: The rate of airflow (CFM) through a unit area (sq.ft.) of a material driven by unit static pressure difference (Pa) across the material (example: 0.004CFM/sq.ft. @ 75 Pa).

K. BAS: Building Automation System

L. Basis of Design (BOD): The Engineer's Basis of Design is comprised of two components: The Design Criteria and Design Narrative. These documents record the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines.

M. CC: Controls Contractor

N. Certificate of Readiness (COR): The COR is a document produced by the GC/CM and submitted to the CxA that states specifically indicated systems or equipment are complete installed, started-up, have undergone all testing and checkout and are ready to schedule FPTs.

O. Commissioning Agent (CxA): An independent party, not otherwise associated with the A/E team members or the GC/CM oversees, though he/she may be hired as a subcontractor to them. The CxA directs the day-to-day commissioning activities.

P. Commissioning Issue (Cx Issue): Any component or system condition (static or dynamic) that is in non-conformance with the contract documents, commissioning documents, performance requirements and/or industry standards and adversely affects the commissionability, operability, maintainability, or functionality of a system equipment or components.

Q. Commissioning Issues log: A formal and ongoing record of Commissioning Issues or concerns and their resolution that have been raised by members of the Commissioning Team during the commissioning process. Also known as the Corrective Action Log (CAL).

R. Commissioning Plan (Cx Plan): An overall document that provides the structure, schedule and coordination planning for the commissioning process. The Cx Plan identifies the project's

commissioning goals, commissioning team members and their roles; establishes the scope of commissioning in terms of systems and equipment; and outlines the major commissioning steps during design, construction, acceptance and occupancy phases. The Cx Plan outlines the expectations of the Contractor's organization, scheduling, allocation of resources, documentation, etc., pertaining to the overall commissioning process.

S. Commissioning Final Report: The final document which presents the commissioning process results for the project. Commissioning reports include an executive summary, issues log, deferred our seasonal testing, and recommendation to accept the project.

T. Commissioning Record: A compilation of all commissioning related documents produced as part of the project. This record includes but is not limited to final Cx documents, meeting minutes, start-up documents and more. The Cx Record can be combined with the Cx Final Report or be provided as a stand-alone document.

U. Commissioning Team (CT): The qualified group that will plan and carry out the overall commissioning process. The team is composed of the CxA, OR, A/E Team, GC/CM, Subs, equipment manufacturers and other parties identified by the CxA. The individual participants on the team may change as the design and construction process proceeds. Participation by the OR is not mandatory, but the value of these services to the customer is directly proportional to their participation.

V. Construction Phase: Phase of construction that begins once construction commences and continues until TAB and Functional Performance Testing. This phase includes the commissioning submittal review, development and execution of Pre-Functional Checklists, site observations and equipment startup.

W. Datalogging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data loggers separate from the control system.

X. Deferred Testing: FPT's that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that prevent the test from being executed during the Acceptance Phase of the project.

Y. EC: Electrical Contractor

Z. Functional Performance Test (FPT): Testing and documenting of the dynamic function and operation of equipment and systems to verify and demonstration operation in accordance with the OPR, BOD and contract documents. Using manual (direct observation) and/or monitoring methods, systems and equipment are tested under various conditions, such as low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's Sequences of Operation and components are verified to be responding as the sequences state. The CxA develops the FPT procedures in a sequential written form, coordinates, oversees, and documents the actual testing, which is usually performed by the installing contractor or vendor. FPT's are performed after Pre-Functional Checklists, startup, TAB and controls checkout are complete and the COR is received. The Subs are responsible for reviewing, understanding, and performing the FPT's.

AA. GC/CM: General Contractor / Construction Manager

BB. HVAC: Heating, Ventilating and Air Conditioning

CC. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.

DD. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

EE. MC: Mechanical Contractor

FF. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.

GG. O&M: Operation and Maintenance

HH. Occupancy Phase: Phase of the project after the Acceptance Phase. During this phase, commissioning requirements are to correct any remaining Commissioning Issues, carry out any required re-testing, deferred or seasonal testing, close-out documentation review and warranty review.

II. OR: Owner's Representative

JJ. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50°F to 75°F to verify economizer operation). See also “Simulated Signal”.

KK. PC: Plumbing Contractor

LL. Pre-Functional Checklist (PFC): A list of items to inspect to verify proper installation of equipment and systems. PFCs are developed and provided by the CxA with execution being completed by the Subs, CxA or a combination thereof depending on the scope of services. PFCs are primarily static inspections and procedures to prepare the equipment or system for initial operations (e.g., belt tension, oil levels OK, labels affixed, gages in place, etc.).

MM. Request for Information (RFI): An official document submitted to the A/E to provide clarity or direction on a specific question or issue that has arisen.

NN. Sampling: Performing observation, review, testing or other verification on only a fraction of the total number of identical or near identical pieces of equipment, drawings, events, etc. Sampling techniques include random statistical sampling and less form professional judgment methods.

OO. Seasonal Testing: FPTs that are deferred until the system(s) will experience conditions closer to their design conditions.

PP. Sequence of Operations (SOO): A written description of how equipment and systems are intended to operate. SOOs include control logic, setpoints, alarm requirements, trend requirements and other information necessary to properly program and commission the system. SOOs are developed by the EOR, and final versions are provided by the CC on the approved controls submittal.

QQ. Simulated Condition: Condition that is created for the purpose of testing the response of a system.

RR. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.

SS. Start-up: The initial starting or activating of dynamic equipment, including executing Pre-Functional checklists.

TT. Subs: Subcontractors

UU. TAB: Testing, Adjusting and Balancing

VV. TABC: Testing, Adjusting and Balancing Contractor

WW. Test Procedures: The step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA with assistance and coordination from GC/CM and Subs.

XX. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test procedures are not the detailed test procedures. The test requirements are specified in the Contract Documents.

YY. Trending: Monitoring of BAS information by logging data at set intervals or when there is a change of value.

DIVISION 01 10 00 - CODES AND STANDARDS

GENERAL

Projects for Major Construction shall meet all applicable governing codes, standards and regulations. These codes and standards shall supersede the MSCS Design Principles and Planning Guidelines in event of a conflict. It is the Designer's responsibility to verify all applicable codes are followed.

New Construction and complete renovations must be designed with the intent to build to USGBC LEED Silver Certification standards but will not be certified.

All projects must be checked for Storm Water Regulations and meet the latest standards adopted by Shelby County Water Services. If appeals are filed with Shelby County Government agencies, put "fee waived, Shelby County Agency" on the form. No fee is due for appeals.

The Contractor is responsible for cleaning and waxing of floors by a MSCS approved custodial vendor to ensure that the facility is ready to receive students and staff at the end of the contract in preparation for hand-to-glove take over by custodial cleaning staff, including movement of furniture out of areas of work and back into work areas. Work will be done after hours with no disruption of any school function. Coordinate and schedule cleaning efforts with MSCS custodial staff.

Any new projects or renovations must include new and upgraded DDC controls for any new or existing HVAC equipment for the entire site. See Scope of Work for details and/or allowances.
All duct mounted fresh air or outside dampers shall be controllable in BAS system.
The main office area should be a single zone for the energy management system. Individual spaces should have thermostats for independent control. The HVAC system should be located where it can be serviced without disrupting the entire office area in all new construction.

VENTILATION: Each building or portion shall have the capability to provide ventilation in accordance with ASHRAE 62, based on building classification and occupant load. Special thermostatically controlled ventilation should be provided in boilers and mechanical rooms to prevent excessively high temperatures.

MISCELLANEOUS HVAC ITEMS: Electric unit heaters with built-in thermostats shall be installed in all mechanical rooms in lieu of hot water unit heaters.

Provide dehumidification control in all media centers, libraries, and auditoriums to control and reduce relative humidity.

If a non-Siemens BACnet controller is provided, two (2) manufacturer service tools and one (1) field-grade laptop shall be provided to MSCS.

Identify any existing controls that will be made obsolete by the new project and address them as necessary. All existing proprietary non-BACnet controls shall be upgraded to new BACnet Web-Based stand-alone EMS standard per Division 25 50 00 included in this guideline.
Provide bulb wells in central plant piping for electronic sensors. Coordinate with the control system designers for locations of wells. Show detail of wells on drawings.
All damper operators, control, and service valves to be installed such that they can be serviced by personnel standing on the floor of the Mechanical Room, if possible.

Chiller shall control the pump using a hardwire interlock by BAS contractor. EMS shall enable/disable the chiller. BACnet interface with EMS integrations.
If you have two (2) chillers, provide motorized isolation valves for each chiller. BAS contractor shall incorporate control of the valves. Provide thermal dispersion flow switches and strainer at the chiller. BAS contracts should be provided.
MSCS prefers Chiller to control pumps and tower operation. Design Engineer to evaluate and recommend best control options. MSCS to review Sequence of Operations.
BAS contractor shall provide a head pressure control valve for all water-cooled chillers. Head pressure control valves shall be controlled by their respective chillers.

Water cooled Chillers shall control the cooling tower when possible.
Unit controllers shall have a unit mounted user interface with digital display. Provide wall mounted temp/humidity sensor with LCD display, override, and metal guard.

Demand Control Ventilation with CO2 control measuring sensor to MSCS BACnet front end graphics
Provide control valve per Design Engineer either 2-way/3-way or face/bypass damper. Provide factory or field BACnet DDC controller.

Valve packs shall have circuit setter, control valves, isolation valves, y-strainer with blow out valve, P/T ports.
All water coils shall have stainless steel coil casing and drain pan.

DIVISION 01 20 00 - DRAWINGS, SPECIFICATION & BID ALTERNATE REQUIREMENTS

GENERAL

DRAWINGS: The title sheet of working drawings shall include number of acres, number of classrooms, student capacity, number of parking spaces (standard and handicapped), building data, square footage and building envelope energy performance data.

Copies of all UL Designs utilized for fire rated walls, columns, floor, roof construction and wall penetrations shall be included in the drawings. Any approved modifications to the UL Designs shall be noted.

The AE shall include an ADA compliance policy statement in the construction documents.

The working drawings shall also include a separate set of floor plans showing all code required fire rated walls, occupancy calculations, toilet fixture calculations, and egress travel distances.

SPECIFICATIONS: Ensure that the SCBOE Standard Bidding & Contract Documents, including Division 0 and Invitation to Bid, are used. AE is to confirm with MSCS Procurement department for latest format. These documents will be furnished by the Owner to the Designer.

Ensure that all bidders understand the State laws requiring certain major sub-contractors to be listed on the front of the sealed bid envelope including their license number and date of expiration. HVAC Plumbing, Electrical, Masonry and Geo-Thermal are currently required.
See also *SECTION VIII* – BIDDING PHASE: E. Conducting and Opening.

Ensure the engineering sections (HVAC, Structural, Plumbing and Electrical) do not conflict with the above “front end” documents. Ensure all trades (Architectural, Mechanical, Electrical, Plumbing, Structural, and Civil) have been thoroughly coordinated between drawings and specs.

The General Requirements section of the specifications shall be written by the Designer, shall address coordination of Prime Contractors' work, pre-installation conferences, project progress meetings (OAC), temporary heating, operation of HVAC system (use and changing of filters to be required during construction), shop drawing review, specific site use requirements, and the asbestos statement noted.

DIVISION 01 21 00 – ACCESS TO SITE, PREMISES & EXISTING BUILDINGS

PART 1 GENERAL

RESPONSIBILITY: MSCS policy requires a responsible employee of MSCS to be present at any existing occupied school building whenever outside persons gain access. This person is to be responsible for coordinating with security personnel and monitoring the building to protect MSCS’ property. No person who has not undergone a TBI background check is permitted on school property while children are present.

WORK HOURS: Hours vary from school to school during the school year but generally include a night crew working. During the summer months, all custodians work a regular day shift from 7:00 AM to 3:30 PM or similar hours, without a night shift. AE shall confirm with MSCS PM specific work times for school facility that the project is located.

AFTER HOURS ACCESS: After-hours access, including weekends and holidays, must be submitted and approved through Facilitron. MSCS PM must be notified of all after-hours work.

1.01 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.
B. Arrange use of site and premises to allow:
   1. Work by Others.
   2. Work by Owner.
   3. Use of sites and premises by the public.
C. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.
D. Existing building spaces may not be used for storage.
E. Utility Outages and Shutdown:
   1. Limit disruption of utility services to hours the building is unoccupied.
   2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days' notice to Owner and authorities having jurisdiction.
   3. Limit shutdown of utility services to 4 hours at a time, arranged at least 24 hours in advance with Owner.
   4. Prevent accidental disruption of utility services to other facilities.

1.02 ACCIDENT PREVENTION

A. Contractor shall comply with safety and engineering practices set forth in "Manual of Accident Prevention in Construction", published by Associated General Contractors of America and with all applicable state and local safety and sanitary laws, regulations and ordinances, as well as established safety rules and practices of Owner. Contractor shall, at his own expense, properly protect Owner's property from injury and shall make good any damage to same caused by failure to exercise required care during this work.
B. Contractor shall provide properly maintained warning signs, lights, barricades, railing and other safeguards for protection of workmen and others on or about or adjacent to the work.
C. Contractor shall provide his employees with approved eye protection, protective head gear, etc., while performing work required for this project.

1.03 FIRE-PREVENTION AND PROTECTION

A. Contractors shall take all necessary precautions to guard against and eliminate all possible fire hazards and to prevent damage to any work, equipment and building.
B. No welding, flame cutting or other operations involving use of flame, arcs or sparking devices shall be allowed without adequate protection and shielding. All combustible or flammable material shall be removed from immediate working area and shall be adequately protected with asbestos fire blankets or suitable noncombustible shields. Further, Contractor shall provide necessary personnel and firefighting equipment to effectively control incipient fire resulting from welding, flame cutting or other operation required for demolition work.

DIVISION 01 22 00 – ALLOWANCES

PART 1 GENERAL

Allowances and unit prices shall be kept to a minimum. Ensure that allowances and unit prices are well defined and understandable. Check allowances and unit prices for items that are specified, such as hardware and brick. Provide a section in the specifications that summarizes all allowances.

Ensure that the allowances include but are not limited to the following:

- Installation of Emergency Management System (EMS) controls
- Installation of MLGW electrical, gas, & water systems
- Testing Laboratories
- Undercutting & Backfilling
- Landscaping Requirements- See Shelby County Design Guidelines
- Network Cabling/ Switches/ WAP
- Wireless Equipment
- Security Cabling & Equipment

- Intercom & PA Systems
- Clock Systems
- Low Voltage Systems
- HVAC Commissioning
- Furniture, Fixtures, & Equipment (FF&E)
- Overtime for MSCS Plant/ Building Engineers for after hours, weekends, and holiday work
- Any additional directives that indicate amounts to be charged to the allowance specific to the project.

The contingency allowance shall be indicated as a separate line item on the Contractor's Schedule of Values and as such the General Contractor's overhead, profit, and bond cost for work charged to the allowance shall be considered to be already included in the Contract Sum. Additional General Contractor overhead and profit on the overall work shall not be included in calculations of the cost of additional work charged to the contingency allowance. Subcontractor's overhead and profit may be included in calculations of the cost of additional work charged to the contingency allowance.

The General Contractor's related costs for products, equipment, and labor that they provide as part of additional work charged to the contingency allowance are not part of the Contract Sum and they will be allowed a subcontractor's markup for overhead and profit on those items. These include delivery costs, taxes paid, insurance required, equipment rental, and similar costs in excess of the original contract work.

At project closeout, credit unused contingency amounts back to the Owner by Change Order.

1.01 SECTION INCLUDES

A. Cash allowances.
B. Contingency allowance.
C. Inspecting and testing allowances.
D. Payment and modification procedures relating to allowances.
E. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation.

1.02 RELATED REQUIREMENTS

A. *Division 01 23 00* - Price and Payment Procedures: Additional payment and modification procedures.
B. *Division 01 58 13* - Temporary Project Signage: Graphic Image.

1.03 CASH ALLOWANCES

A. Provide in the Bid and the proposed Contract Sum the amount stated for the purchase of the materials or products herein specified.
B. Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts, less cost of delivery to site, less applicable taxes.
C. Costs Not Included in Cash Allowances: Product delivery to site and handling at the site, including unloading, uncrating, and storage; protection of products from elements and from damage; and labor for installation and finishing.
D. Architect/Engineer Responsibilities:
    1. Consult with Contractor for consideration and selection of products, suppliers, and installers.
    2. Select products in consultation with Owner and transmit decision to Contractor.
    3. Prepare Change Order.
E. Contractor Responsibilities:
    1. Assist Architect/Engineer in selection of products, suppliers, and installers.
    2. Obtain proposals from suppliers and installers and offer recommendations.
    3. On notification of which products have been selected, execute purchase agreement with designated supplier and installer.
    4. Determine if the anticipated delivery dates of the selected materials or products will have any adverse effect on the construction schedule and so advise the Architect/Engineer.
    5. Arrange for and process shop drawings, product data, and samples. Comply with the pertinent provisions of Section 01 3000.

6. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.
7. Arrange for delivery and installation. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
8. Contractor Records:
    a. Maintain accurate records in order to establish and confirm the amounts disbursed for the purchase of the specified materials or products.
    b. Keep all invoices, receipts or delivery slips of transactions relative to the purchase of the specified materials or products and submit with the pertinent Application for Payment.
    c. Payment of sums against the allowances will be made only if substantiated by appropriate records.

F. Differences in costs will be adjusted by Change Order:
1. If the amount spent to purchase the specified materials or products exceeds the specified allowance, the Contractor will be compensated for the extra cost plus a reasonable amount for overhead and profit.
2. If the amount spent to purchase the specified materials or products is less than the specified allowance, the difference will be credited to the Owner on the Contractor's final Application for Payment.

G. Unused Materials:
1. Return unused materials to the manufacturer or supplier for credit to the Owner, after installation has been completed and accepted.
    a. When requested by the Architect/Engineer, prepare unused material for storage by Owner where it is not economically practical to return the material for credit. When directed by the Architect/Engineer, deliver unused material to the Owner's storage space. Otherwise, disposal of unused material is the Contractor's responsibility.

1.04 CONTINGENCY ALLOWANCE

A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.
B. Funds will be drawn from the Contingency Allowance only by Change Order.
C. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

1.05 INSPECTING AND TESTING ALLOWANCES

A. Costs Included in Inspecting and Testing Allowances: Cost of engaging an inspecting or testing agency; execution of inspecting and tests; and reporting results.
B. Costs Not Included in the Inspecting and Testing Allowances:
1. Costs of incidental labor and facilities required to assist inspecting or testing agency.
2. Costs of testing services used by Contractor separate from Contract Document requirements.
3. Costs of retesting upon failure of previous tests as determined by Architect/Engineer.

C. Payment Procedures:
1. Submit one copy of the inspecting or testing firm's invoice with next application for payment.
2. Pay invoice on approval by Architect/Engineer.

D. Differences in cost will be adjusted by Change Order.

DIVISION 01 23 00 – PRICE AND PAYMENT PROCEDURE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.
B. Documentation of changes in Contract Sum and Contract Time.
C. Change procedures.
D. Correlation of Contractor submittals based on changes.
E. Procedures for preparation and submittal of application for final payment.

1.02 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.
B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect/Engineer for approval.
C. Forms filled out by hand will not be accepted.
D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.
F. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
G. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
H. Revise schedule to list approved Change Orders, with each Application For Payment.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.
B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.
C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect/Engineer for approval.
D. Forms filled out by hand will not be accepted.
E. For each item, provide a column for listing each of the following:
    1. Item Number.
    2. Description of work.
    3. Scheduled Values.
    4. Previous Applications.
    5. Work in Place and Stored Materials under this Application.
    6. Authorized Change Orders.
    7. Total Completed and Stored to Date of Application.
    8. Percentage of Completion.
    9. Balance to Finish.
    10. Retainage.
F. Execute certification by signature of authorized officer.
G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
I. Submit one electronic and three hard copies of each Application for Payment.
J. Include the following with the application:
    1. Transmittal letter as specified for submittals in *Division 01 30 00*.
    2. Construction progress schedule revised and current as specified in *Division 01 30 00*.
    3. Current construction photographs specified in *Division 01 30 00*.
    4. Partial release of liens from major subcontractors and vendors.
    5. Project record documents as specified in *Division 01 78 00*, for review by Owner which will be returned to the Contractor.
    6. Affidavits attesting to off-site stored products.
K. When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.04 MODIFICATION PROCEDURES

A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to Contract Documents.
B. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect/Engineer will issue instructions directly to Contractor.
C. For other required changes, Architect/Engineer will issue a document signed by Owner

instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
2. Promptly execute the change.

D. For changes for which advance pricing is desired, Architect/Engineer will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within ____ days.

E. Contractor may propose a change by submitting a request for change to Architect/Engineer, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with *Division 01 25 00*.

F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
1. For change requested by Architect/Engineer for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect/Engineer.
3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
4. For change ordered by Architect/Engineer without a quotation from Contractor, the amount will be determined by Architect/Engineer based on the Contractor's substantiation of costs as specified for Time and Material work.

G. Substantiation of Costs: Provide full information required for evaluation.
1. On request, provide the following data:
   a. Quantities of products, labor, and equipment.
   b. Taxes, insurance, and bonds.
   c. Overhead and profit.
   d. Justification for any change in Contract Time.
   e. Credit for deletions from Contract, similarly documented.
2. Support each claim for additional costs with additional information:
   a. Origin and date of claim.
   b. Dates and times work were performed, and by whom.
   c. Time records and wage rates paid.
   d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

H. Execution of Change Orders: Architect/Engineer will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

K. Promptly enter changes in Project Record Documents.

1.05 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
1. All closeout procedures specified in *Division 01 70 00*.
2. Completion of items specified for completion beyond time of substantial completion (regardless of whether payment application was previously made).
3. Assurance, satisfactory to the Owner, that unsettled claims will be settled and that work not actually completed and accepted will be completed without undue delay.
4. Transmittal of required project construction records to Owner.

5. Proof, satisfactory to Owner, that taxes, fees and similar obligations of Contractor have been paid.
6. Removal of temporary facilities, services, surplus materials, rubbish and similar elements.
7. Change over of door locks and other Contractor's access provisions to Owner's property.

DIVISION 01 24 00 - PROJECT SCHEDULING

GENERAL

All Major Construction services shall provide a Construction Baseline Schedule specific to the project and services provided. The Construction Baseline Schedule will be utilized during the project in relation to the Major Construction progress schedules that are provided with each invoice and pay application to monitor any and all impacts to the schedules.

The construction projects shall be planned, scheduled, executed, reported and accomplished using the Critical Path Method (CPM) in calendar days.
The primary objectives of the use of the CPM: (1) to ensure adequate planning and execution of the Work by Contractor; (2) to assist Owner in evaluating progress of the Work; (3) to provide for optimum coordination by Contractor of their trades, Subcontractors and Suppliers, and of their Work with the work or services provided by any separate contractors; (4) to permit the timely prediction or detection of events or occurrences which may affect the timely completion of the Work; (5) to provide a mechanism or tool for use by the Owner and Contractor in determining and monitoring any actions of the Contractor which may be required in order to comply with the requirements of the Contract Documents relating to the completion of the various portions of the Work by the Specific Dates; (6) assist the Owner in scheduling Owner supplied and Installed items.

Each line item from the Schedule of Values (SOV) will be associated with an activity on the construction schedule. The activity will be coded to correspond to the trade, subcontractor or supplier performing the work. Each line item shall be broken down into labor and materials.

During the preparation of the Contract Documents, the MSCS PM will provide critical milestone dates to be included in the Bid Form for the project.
The architect or designer shall consult with the contractor through the construction process to ensure the construction process is maintained for timely construction completion. Should the contractor fall behind schedule, the AE shall confer with the contractor and shall determine steps necessary to meet schedule compliance. The consultants shall advise the MSCS PM and Director of those measures taken to correct construction schedule.

DIVISION 01 25 00 – SUBSTITUTION PROCEDURE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. *Division 01 30 00* - Administrative Requirements: Submittal procedures, coordination.
B. *Division 01 60 00* - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 EXECUTION

2.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.
   6. Agrees to reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
   1. Note explicitly any non-compliant characteristics.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.

D. Limit each request to a single proposed substitution item.
   1. Submit an electronic document, combining the request form with supporting data into single document.

2.02 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

E. Submittal Form (after award of contract):
   1. Submit substitution requests by completing the form attached to this section. See this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.

F. Architect/Engineer will consider requests for substitutions only within 15 days after date of Agreement.

G. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect/Engineer, in order to stay on approved project schedule.

H. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect/Engineer, in order to stay on approved project schedule.
   1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
   2. Document means of coordinating substitution items with other portions of the work, including work by affected subcontractors.
   3. Bear the costs engendered by proposed substitution of:
      a. Owner's compensation to the Architect/Engineer for any required redesign, time spent processing and evaluating the request.
      b. Other construction by Owner.
      c. Other unanticipated project considerations.

I. Substitutions will not be considered under one or more of the following circumstances:
   1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
   2. Without a separate written request.
   3. When acceptance will require revisions to Contract Documents.

2.03 RESOLUTION

A. Architect/Engineer may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

1. Architect/Engineer's decision following review of proposed substitution will be noted on the submitted form.

2.04 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

2.05 CLOSEOUT ACTIVITIES

A. See *Division 01 79 00* - Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests. Refer to Appendix – for the form.

DIVISION 01 26 00 – WEATHER DAYS

PART 1 GENERAL

1.01 REQUIREMENTS

A. Wet Conditions: The required time of completion is given in calendar days in the Bid Form (which becomes part of the Contract). It is expressly understood and agreed, by and between the Contractor and Owner, that the time for completion of the work described in the bid form is a reasonable time for completion of the same, taking into consideration the average climatic range and usual lost time due to normal seasonal weather in this locality.

1. Time for completion in the Bid Form includes the average number of days that are lost due to wet conditions. The table below shows the average number of days lost in each month due to wet conditions on outdoor or exposed interior work of projects.
   These days are derived from historical data provided by the National Climatic Data Center regarding rainfall for Memphis, TN and Nashville, TN. They represent a number less than the actual number of days of measurable rainfall that can be expected to occur during a twenty-four (24) hour period for the months indicated.

MONTH	AVERAGE DAYS LOST TO NORMAL WET CONDITIONS
January	8
February	8
March	8
April	9
May	7
June	4
July	6
August	5
September	7
October	6
November	6
December	7

2. Based on rainfall data provided by the National Climatic Data Center for Memphis and Nashville. The total contract time includes these days that are expected to be lost each month.
   a. Definition of Rain Day: Precipitation (rain, snow, or ice) in excess of one-tenth of an inch (0.10") liquid measure in a 24-hour period.

B. Ice, Standing Snow and Frozen Ground:

1. In addition to work being delayed due to wet conditions (See 1.01 A. above), it is recognized that the work may also be delayed due to certain conditions relating to ice, snow and frozen ground; and loss of working time may also be claimed for such last-mentioned conditions in accordance with the provisions of this paragraph. The average number of days lost per month in this locality due to ice, standing snow and frozen ground conditions shall be considered zero, however, lost days due to ice, standing snow and frozen ground conditions may be claimed if it is caused by one or more of the following conditions which prevent outside construction activity or access to the site within a 24-hour period:
   a. Ice which does not melt on a substantial portion of the project by 10 A.M.
   b. Temperatures which do not rise above 32 degrees F by 10 A.M.

c. Standing snow in excess of one inch (1.00”).
d. Precipitation (rain, snow, or ice) in excess of one-tenth of an inch (0.10") liquid measure in a 24-hour period.

C. Further Provisions Regarding Time for Completion:
1. A weather delay day may be counted, if appropriate, for dry-out days when the following conditions are met:
a. If there is a hindrance to site access; work on the envelope of the building such as masonry or roofing; site work such as excavation, backfill, or footings; and site improvements such as paving.
b. At a rate no greater than one (1) make-up day for each day or consecutive days of rain beyond the Standard Baseline that total one inch (1.00”) or more, liquid measure.
2. A weather delay day may be counted only if worse than average weather prevents work on the project for 50 percent or more of the Contractor’s scheduled workday.
3. The Contractor must submit Daily Jobsite Work Log showing which and to what extent construction activities have been affected by weather, on a monthly basis.
4. The Contractor must submit actual weather data to support a claim for the time extension obtained from nearest NOAA weather station or other independently verified source approved by the Owner at the beginning of the project.
5. The Contractor must maintain a rain gauge, thermometer and clock at the job site. Keep daily records of precipitation, temperature and the time of each occurrence throughout the project.
6. The Contractor must organize claim and documentation to facilitate evaluation on a basis of calendar month periods and submit monthly to the Owner.
7. If an extension of the contract time is appropriate, it shall be effected in accordance with the provisions of the General Conditions of this contract.
8. No extra cost will be incurred by the Owner for any extra time increase to the contract.

1.02 EXAMPLE

A. The following example is given for further clarification of how extra time for wet conditions and/or ice, standing snow and frozen ground is to be calculated. If wet conditions were to occur for a total of sixteen (16) days during the month of January, then the extra contract time allowed would be 16 days minus 8 days (from table above), or 8 days which may be rounded up to the nearest whole day. Also, if during the same month there was standing snow on any combination of conditions as in above for three (3) days, then the Contractor would be allowed an extra 3.0 days in addition to the 8.0 days for wet conditions. The Contractor would get a total of 11.0 extra days. No extra cost will be incurred by the Owner for any extra time increase to the Contract.

DIVISION 01 30 00 – ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preconstruction meeting.
B. Progress meetings.
C. Construction progress schedule.
D. Contractor's daily reports.
E. Progress photographs.
F. Coordination drawings.
G. Submittals for review, information, and project closeout.
H. Number of copies of submittals.
I. Requests for Interpretation (RFI) procedures.
J. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. *Division 01 60 00* - Product Requirements: General product requirements.
B. *Division 01 70 00* - Execution and Closeout Requirements: Additional coordination requirements.
C. *Division 01 79 00* - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 PROJECT COORDINATOR

A. Construction Manager/General Contractor is responsible for Project Coordination.
B. Coordinate allocation of mobilization areas of site; for field offices and sheds, storage of materials, for access, traffic, and parking facilities.
C. Coordinate use of sites and facilities during construction.
D. Coordinate and comply with procedures for intra-project communication; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
E. Coordinate use of temporary utilities and construction facilities.
F. Coordinate field engineering and layout work.
G. Coordinate and make the following types of submittals to Architect/Engineer:
    1. Requests for interpretation.
    2. Requests for substitution.
    3. Shop drawings, product data, and samples.
    4. Test and inspection reports.
    5. Design data.
    6. Manufacturer's instructions and field reports.
    7. Applications for payment and change order requests.
    8. Progress schedules.
    9. Coordination drawings.
    10. Correction Punch List and Final Correction Punch List for Substantial Completion.
    11. Closeout submittals.

PART 2 EXECUTION

2.01 PRECONSTRUCTION MEETING

A. Construction Manager/General Contractor will schedule a meeting after Notice of Award
B. Attendance Required:
    1. Owner.
    2. Architect/Engineer.
    3. Contractor.
    4. Representatives of the major subcontractors.
    5. Other representatives.
C. Agenda:
    1. Execution of Owner-Contractor Agreement.
    2. Submission of executed bonds and insurance certificates.
    3. Distribution of Contract Documents.
    4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
    5. Submission of initial Submittal schedule.
    6. Designation of personnel representing the parties to the Contract: Owner, Contractor and Architect/Engineer.
    7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal requests, Change Orders, and Contract closeout procedures.
    8. Major equipment deliveries and priorities, handling of materials to permit inspection, storage of material off-site.
    9. Scheduling. Sequence of critical work. Review of schedules.
    10. Trades whose work will require pre-start up and workmanship review meetings.
    11. Use of premises, access to sites, field office and storage areas, security procedures and Owner's requirements.
    12. Payment procedures after substantial completion.
    13. Additional items and subjects requested by the Owner, Contractor and Architect/Engineer.
D. Construction Manager/General Contractor will act as chairperson of the meeting; record minutes and distribute copies within two days after meeting to participants, with one copy to Architect/Engineer, Contractor, participants, and those affected by decisions made.

2.02 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside over meetings.
C. Agenda:
    1. Review minutes of previous meetings.
    2. Review of work progress.
    3. Field observations, problems, and decisions.
    4. Identification of problems that impede, or will impede, planned progress.
    5. Review of submittals schedule and status of submittals.
    6. Review of RFIs log and status of responses.
    7. Review of off-site fabrication and delivery schedules.
    8. Maintenance of progress schedule.
    9. Corrective measures to regain projected schedules.
    10. Planned progress during succeeding work period.
    11. Coordination of projected progress.
    12. Maintenance of quality and work standards.
    13. Effect of proposed changes on progress schedule and coordination.
    14. Other business relating to Work. Other current business.
D. Record minutes and distribute copies within two days after meeting to participants, with one copy to Architect/Engineer, Owner, participants, and those affected by decisions made.

2.03 CONSTRUCTION PROGRESS SCHEDULE

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
1. Include written certification that major contractors have reviewed and accepted proposed schedule.
D. Within 10 days after joint review, submit complete schedule.
E. Submit updated schedule with each Application for Payment.

2.04 DAILY CONSTRUCTION REPORTS

A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.
B. In addition to transmitting electronically a copy to Owner and Architect/Engineer, submit one printed copies at monthly intervals.
    1. Submit in format acceptable to Owner.
C. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
    1. Date.
    2. High and low temperatures, and general weather conditions.
    3. List of subcontractors at Project site.
    4. List of separate contractors at Project site.
    5. Approximate count of personnel at Project site.
        a. Include a breakdown for supervisors, laborers, journeymen, equipment operators, and helpers.
    6. Major equipment at Project site.
    7. Material deliveries.
    8. Safety, environmental, or industrial relations incidents.
    9. Meetings and significant decisions.
    10. Unusual events (submit a separate special report).
    11. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
    12. Meter readings and similar recordings.
    13. Emergency procedures.
    14. Directives and requests of Authority(s) Having Jurisdiction (AHJ).

15. Change Orders received and implemented.
16. Testing and/or inspections performed.
17. List of verbal instruction given by Owner and/or Architect/Engineer.
18. Signature of Contractor's authorized representative.

2.05 PROGRESS PHOTOGRAPHS

A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.

B. Maintain one set of all photographs at project site for reference; same copies as submitted, identified as such.

C. Photography Type: Digital; electronic files.

D. Provide photographs of sites and construction throughout progress of work produced by an experienced photographer, acceptable to Architect/Engineer.

E. In addition to periodic, recurring views, take photographs of each of the following events:
   1. Completion of site clearing.
   2. Excavations in progress.
   3. Foundations in progress and upon completion.
   4. Structural framing in progress and upon completion.
   5. Enclosure of building, upon completion.
   6. Final completion, minimum of ten (10) photos.

F. Take photographs as evidence of existing project conditions as follows:
   1. Interior views.
   2. Exterior views.

G. Views:
   1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
   2. Consult with Architect/Engineer for instructions on views required.
   3. Provide factual presentation.
   4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
   5. Point of View Sketch: Provide sketch identifying point of view of each photograph.

H. Digital Photographs: 24-bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Via email with project record photo CD.
   2. File Naming: Include project identification, date and time of view, and view identification.
   3. Point of View Sketch: Include digital copy of point of view sketch with each electronic submittal; include point of view identification in each photo file name.
   4. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
   5. Photo CD(s): Provide 1 copy including all photos cumulative to date and PDF file(s), with files organized in separate folders by submittal date.

2.06 COORDINATION DRAWINGS

A. Provide information required for preparation of coordination drawings.

B. Review drawings prior to submission to Architect/Engineer.

2.07 REQUESTS FOR INTERPRETATION/INFORMATION (RFI)

A. Definition: A request seeking one of the following:
   1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
   2. A resolution to an issue which has arisen due to field conditions and affects design intent.

B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.

C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
   1. Prepare a separate RFI for each specific item.

a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
b. Do not forward requests which solely require internal coordination between subcontractors.

2. Prepare using an electronic version of the form appended to this section.
3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
a. Approval of submittals (use procedures specified elsewhere in this section).
b. Approval of substitutions (see Section - 01 6000 - Product Requirements)
c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect/Engineer, and any of its consultants, due to processing of such RFIs.

E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number, and any additional required identifiers established in Contract Documents.
2. Owner's, Architect/Engineer's, and Contractor's names.
3. Discrete and consecutive RFI number, and descriptive subject/title.
4. Issue date and requested reply date.
5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
2. Note dates of when each request is made, and when a response is received.
3. Highlight items requiring priority or expedited response.
4. Highlight items for which a timely response has not been received to date.
5. Identify and include improper or frivolous RFIs.

H. Review Time: Architect/Engineer will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
1. Response period may be shortened or lengthened for specific items, subject to mutual

agreement, and recorded in a timely manner in progress meeting minutes.

I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
   1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
   2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
   3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
   4. Notify Architect/Engineer within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

2.08 SUBMITTAL SCHEDULE

A. Submit to Architect/Engineer for review a schedule for submittals in tabular format.
   1. Submit at the same time as the preliminary schedule specified for the Construction Progress Schedule.
   2. Coordinate with Contractor's construction schedule and schedule of values.
   3. Format schedule to allow tracking of status of submittals throughout duration of construction.
   4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
   5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
      a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

2.09 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Design data.
   3. Shop drawings.
   4. Samples for selection.
   5. Samples for verification.
   6. Other types indicated.

B. Submit to Architect/Engineer for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and *01 79 00* - Closeout Submittals.

2.10 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Sustainability design submittals and reports.
   3. Certificates.
   4. Test reports.
   5. Inspection reports.
   6. Manufacturer's instructions.
   7. Manufacturer's field reports.
   8. Other types indicated.

B. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.

2.11 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

2.12 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents for Review: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Documents for Review:
   1. Small Size Sheets, Not Larger Than 8-1/2 by 11 inches: Submit one copy; the Contractor shall make Contractor's own copies from original returned by the Architect/Engineer after making a file copy.
   2. Larger Sheets, Not Larger Than 36 x 48 inches (910 x 1220 mm): Submit two opaque reproductions; one copy will be retained by Architect/Engineer.

C. Documents for Information: Submit one copy.

D. Extra Copies at Project Closeout: See *Division 01 79 00*.

E. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect/Engineer.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

2.13 SUBMITTAL PROCEDURES

A. General Requirements:
   1. All submittals to Architect/Engineer are to be sent via email.
   2. Use a single transmittal for related items.
   3. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
   4. Transmit using approved form.
      a. Use Contractor's form, subject to prior approval by Architect/Engineer.
   5. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
   6. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
   7. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
      a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
   8. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
      a. Deliver submittals to Architect/Engineer at business address.
      b. Send submittals in electronic format via email to Architect/Engineer.
   9. Schedule submittals to expedite the Project, and coordinate submission of related items.
      a. For each submittal for review, allow 15 working days excluding delivery time to and from the Contractor.
      b. For sequential reviews involving Architect/Engineer's consultants, Owner, or another affected party, allow an additional 7 working days.
      c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect/Engineer's approval, allow an additional 30 days.
   10. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
   11. Provide space for Contractor and Architect/Engineer review stamps.

12. When revised for resubmission, identify all changes made since previous submission.
13. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
14. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
15. Submittals not requested will not be recognized or processed.

B. Product Data Procedures:
1. Submit only information required by individual specification sections.
2. Collect required information into a single submittal.
3. Submit concurrently with related shop drawing submittal.
4. Do not submit (Material) Safety Data Sheets for materials or products.
5. Submit sustainable design reporting submittals under separate cover.

C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
2. Do not reproduce Contract Documents to create shop drawings.
3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.

2.14 SUBMITTAL REVIEW

A. Submittals for Review: Architect/Engineer will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Architect/Engineer will acknowledge receipt and review.

C. Architect/Engineer's actions will be reflected by marking each returned submittal using actual stamp on hard copies of submittals.
1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.

D. Architect/Engineer's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
a. No Exceptions Taken: Where the submittal is marked "No Exceptions Taken," the Work covered by the submittal may proceed provided it complies with the Contract Documents. Final acceptance will depend on that compliance. Do not resubmit.
b. Exceptions Taken As Noted: Where the submittal is marked " Exceptions Taken As Noted," the work covered by the submittal may proceed provided it complies both with Architect's notations on the submittal and the Contract Documents. Final acceptance will depend on that compliance. Do not resubmit.
c. Make Corrections Noted: Where submittal is marked "Make Corrections Noted," the work covered by the submittal may proceed provided it complies both with Architect's correction notations on the submittal and the Contract Documents. Final acceptance will depend on that compliance. Do not resubmit.
2. Not Authorizing fabrication, delivery, and installation:
a. Revise and Resubmit: Where the submittal is marked "Revise and Resubmit," do not proceed with the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity for the product submitted. Revise and prepare a new submittal according to Architect's notations and corrections.
b. Submit Specified Item: Where the submittal is marked "Submit Specified Item," do not proceed with the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity for the product submitted. Revise and prepare a new submittal according to Architect's notations and corrections.
c. Rejected: Where the submittal is marked "Rejected," do not proceed with the Work covered by the submittal. Prepare a new submittal for a product that complies with the Contract Documents.

E. Architect/Engineer's and Consultants' actions on items submitted for information:
   1. Items for which no action was taken:
      a. "Received" - to notify the Contractor that the submittal has been received for record only.
   2. Items for which action was taken:
      a. "Reviewed" - no further action is required from Contractor.
F. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
G. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

DIVISION 01 40 00 – QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.
B. Testing and inspection agencies and services.
C. Control of installation.
D. Mock-ups.
E. Tolerances.
F. Manufacturers' field services.
G. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. *Division 01 22 00* - Allowances: Allowance for payment of testing services.
B. *Division 01 30 00* - Administrative Requirements: Submittal procedures.
C. *Division 00 00 00* - Definitions.
D. *Division 01 60 00* - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2014).
B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2017.
C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2015a, with Editorial Revision (2016).
D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.
E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2018.
F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2015.
G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
H. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2017.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Design Data: Submit for Architect/Engineer's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect/Engineer and to Contractor.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.

h. Date of test/inspection.
i. Results of test/inspection.
j. Compliance with Contract Documents.
k. When requested by Architect/Engineer, provide interpretation of results

2. Test report submittals are for Architect/Engineer's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect/Engineer, in quantities specified for Product Data.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
2. Certificates may be recent or previous test results on material or product but must be acceptable to Architect/Engineer.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

F. Manufacturer's Field Reports: Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.
1. Submit report in duplicate within seven (7) days of observation to Architect/Engineer for information.
2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

G. Erection Drawings: Submit drawings for Architect/Engineer's benefit as contract administrator or for Owner.
1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner.

1.05 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 01 2100; see Section 01 2100 and applicable sections for description of services included in allowance.

B. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.

C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

D. Contractor Employed Agency:
1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM E699, ASTM C1021, ASTM C1077, ASTM C1093, and ASTM D3740.
2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
3. Laboratory Qualifications: Accredited by IAS according to IAS AC89.
4. Laboratory: Authorized to operate in the State in which the Project is located.
5. Laboratory Staff: Maintain a full-time registered Engineer on staff to review services.
6. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
E. Have work performed by persons qualified to produce required and specified quality.
F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
G. Secure products in place with positive anchorage devices designed and sized to withstand stress, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.
B. Testing Agency Duties:
    1. Test samples of mixes submitted by Contractor.
    2. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.
    3. Perform specified sampling and testing of products in accordance with specified standards.
    4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
    5. Promptly notify Architect/Engineer and Contractor of observed irregularities or non-compliance of Work or products.
    6. Perform additional tests and inspections required by Architect/Engineer.
    7. Attend preconstruction meetings and progress meetings.
    8. Submit reports of all tests/inspections specified.
C. Limits on Testing/Inspection Agency Authority:
    1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
    2. Agency may not approve or accept any portion of the Work.
    3. Agency may not assume any duties of Contractor.
    4. Agency has no authority to stop the Work.
D. Contractor Responsibilities:
    1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
    2. Cooperate with laboratory personnel and provide access to the Work and to manufacturers' facilities.
    3. Provide incidental labor and facilities:
        a. To provide access to Work to be tested/inspected.
        b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
        c. To facilitate tests/inspections.
        d. To provide storage and curing of test samples.
    4. Notify Architect/Engineer and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
    5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect/Engineer.
F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Architect/Engineer 30 days in advance of required observations.

1. Observer subject to approval of Architect/Engineer.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

DIVISION 01 42 16 – DEFINITIONS

PART 1 GENERAL

1.01 SUMMARY

A. General Explanation: A substantial amount of specification language constitutes definitions for terms found in other contract documents, including the drawings which must be recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in the contract documents are defined generally in this article. Definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the work to extents not stated more explicitly in another provisions of the contract documents. This section supplements the definitions contained in the General Conditions.

B. General Requirements: The provisions or requirements of Division 01 sections. General requirements apply to either work of contract and, where so indicated, to other elements of work which are included in the project. Other definitions are included in individual specification sections.

C. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

A. Indicated: The term “Indicated” is a cross-reference to details, notes or schedules on the drawings, to other paragraphs or schedules in the Project Manual, and to similar means of recording requirements in the contract documents. Where terms such as “shown”, “noted”, “scheduled”, and “specified” are used in lieu of “indicated”, it is for the purpose of helping the reader locate cross-reference, and no limitation of location is intended except as specifically noted.

B. Directed, Requested, etc.: Where not otherwise explained, terms such as “directed”, “requested”, “authorized”, “selected”, “approved”, “required”, “accepted” and “permitted” mean “directed by Architect/Engineer”, “requested by Architect/Engineer”, etc. However, no such implied meaning will be interpreted to extend Architect/Engineer’s responsibility into Contractor’s area of construction supervision.

C. Approved: Where used in conjunction with Architect/Engineer’s response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term “approved” will be held to limitations of Architect/Engineer’s responsibility and duties as specified in general and Supplementary Conditions. In no case will “approval” by Architect/Engineer be interpreted as a release of Contractor from responsibilities to fulfill requirements of the contract documents.

D. Project Site: The space available to Contractor for performance of the work, either exclusively or in conjunction with others performing other work as part of the project. The extent of project site is shown on the drawings and may or may not be identical with description of the land upon which project is to be built.

E. Furnish: To supply and deliver to project site, ready for unloading, unpacking, inspect for damage, assembly, installation, etc., as applicable in each instance.

F. Install: Operations at project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning, start up and similar operations, make ready for use, as applicable in each instance.

G. Provide: Except as otherwise defined in greater detail, term “provide” means furnish and install, complete and ready for intended use, as applicable in each instance.
H. Installer: The entity (person or firm) engaged by the Contractor or its subcontractor or sub subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application, and similar required operations. It is a general requirement that such entities (installers) be expert in operations they are engaged to perform.
I. Testing Laboratory: An independent entity engaged to perform specific inspections or tests of the work, at project site and to report and (if required) interpret results of those inspections or tests. Refer to *Division 01 40 00.*
J. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
K. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.

1.03 FORMAT AND SPECIFICATION EXPLANATIONS

A. Specification Production: None of these explanations will be interpreted to modify substance of requirements. Portions of these specifications have been produced by Architect’s standard methods of editing master specifications and may contain minor deviations from traditional writing formats. Such deviations are a normal result of this production technique, and no other meaning will be implied or permitted.
B. Format Explanation: The format of principal portions of these specifications can be described as follows; although other portions may not fully comply and no particular significance will be attached to such compliance or non-compliance:
    1. Sections and Divisions: For convenience, basic unit of specification text is a “section”, each unit of which is named and numbered. These are organized into related families of sections, and various families of sections are organized into “divisions”, which are recognized as the present industry - consensus on uniform organization and sequencing of specifications. The section title is not intended to limit meaning or content of section, nor to be fully descriptive of requirements specified therein, nor to be an integral part of text.
        a. Each section of specifications has been subdivided into 3 (or less), “parts” for uniformity and convenience (Part 1 - General, Part 2 - Products, and Part 3 - Execution). These do not limit the meaning and are not an integral part of text which specifies requirements.
C. Imperative Language: Used generally in specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities which must be fulfilled indirectly by Contractor, or when so noted, by others.
D. Section Numbering: Used to facilitate cross-references in contract documents. Sections are placed in Project Manual in numeric sequence; however, numbering sequence is not complete, and listing of sections at beginning of Project Manual must be consulted to determine numbers and names of specification sections in the contract documents.
E. Page Numbering: Numbered independently for each section; recorded in listing of section (Index or Table of Contents) in Project Manual. Section number is shown with page number at bottom of each page, to facilitate location of text in Project Manual.
F. Specification Content: Because of methods by which this project specification has been produced, certain general characteristics of content, and conventions in use of language are explained as follows:
    1. Specifying Methods: The techniques or methods of specifying to record requirements varies throughout text, and may include “prescriptive”, “open generic - descriptive”, “compliance with standards”, “performance”, “proprietary” or a combination of these. The method used for specifying one unit of work has no bearing on requirements for another unit of work.
    2. Overlapping and Conflicting Requirements: Where compliance with 2 or more industry standards or sets of requirements is specified, and overlapping of those different standards or requirements establishes different or conflicting minimum or levels of quality, the most stringent requirement (which is generally recognized to be most costly) is intended and will

be enforced, unless specifically detailed language written into the contract documents (not by way of reference to an industry standard) clearly indicates that a less stringent requirement is to be fulfilled. Refer apparently-equal-but-different requirements and uncertainties as to which level of quality is more stringent to Architect for decision before proceeding.

a. Contractor's Options: Except for overlapping or conflicting requirements, where more than one set of requirements are specified for a particular unit of work, option is intended to be contractor's regardless of whether specifically indicated as such.

3. Minimum Quality/Quantity: In every instance, quality level or quantity shown or specified is intended as minimum for the work to be performed or provided. Except as otherwise specifically indicated, actual work may either comply exactly with that minimum within specified tolerances or may exceed that minimum within reasonable limits. In complying with requirements, indicated numeric values are either minimums or maximums as noted or as appropriate for context of requirements. Refer instances of uncertainty to Architect for decision before proceeding.
4. Specialist's Assignments: In certain instances, specification text requires (or at least implies) that specific work be assigned to specialists or expert entities, who must be engaged for performance of those units of work. These must be recognized as special requirements over which Contractor has no choice or option. These assignments must not be confused with (and are not intended to interfere with) normal application of regulations, union jurisdictions and similar conventions. One purpose of such assignments is to establish which party or entity involved in a specific unit of work is recognized as "expert" for indicated construction processes or operations. Nevertheless, final responsibility for fulfillment of entire set of requirements remains with Contractor.
5. Trades: Except as otherwise indicated, the use of titles (such as "carpentry") in specification text, implies neither that the work must be performed by an accredited or unionized tradesman of the corresponding generic name (such as "carpenter"), nor that specified requirements apply exclusively to work by tradesman of the corresponding generic name.
6. Abbreviations: The language of specifications and other contract documents is of the abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual work abbreviations of a self-explanatory nature have been included in the text. Specific abbreviations have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of specification requirements with notations on drawings and in schedules.
    a. These are frequently defined in sections at first instance of use. Trade association names and titles of general standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the contract documents so indicate.

1.04 DRAWING SYMBOLS

A. General: Except as otherwise indicated, graphic symbols used on drawings are those symbols recognized in the construction industry for purposes indicated. Where not otherwise noted, symbols are defined by "Architectural Graphic Standards", published by John Wiley & Sons, Inc., latest edition.

1.05 INDUSTRY STANDARDS

A. General Applicability of Standards: Applicable standards of construction industry have same force and effect (and are made a part of contract documents by reference) as if copied directly into contract documents, or as if published copies were bound herewith.
    1. Referenced standards (referenced directly in contract documents or by governing regulations) have precedence over non-referenced standards which are recognized in industry for applicability to work.
    2. Non-referenced standards recognized in the construction industry are hereby defined, except as otherwise limited in contract documents, to have direct applicability to the work, and will be so enforced for performance of the work.
B. Publication Dates: Except as otherwise indicated, where compliance with an industry standard is required, comply with standard in effect as of date in contract documents.

C. Copies of Standards: Provide where needed for proper performance of the work; obtain directly from publication sources.
D. Abbreviations and Names: Where acronyms or abbreviations are used in specifications or other contract documents, they are defined to mean the industry recognized name and trade association, standards generating organization, governing authority or other "Encyclopedia of Associations", published by Gale Research Co., available in large libraries.

1.06 GOVERNING REGULATIONS/AUTHORITIES

A. General: The procedure followed by the Architect has been to contact governing authorities where necessary to obtain information needed for the purpose of preparing the contract documents; recognizing that such information may or may not be of significance in relation to the Contractor's responsibilities for performing the work. Contact governing authorities directly for necessary information and decisions having a bearing on the performance of the work.

1.07 SUBMITTALS

A. Permits, Licenses and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the work.

DIVISION 01 43 39 – MOCK-UPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Integrated Exterior Mockups.
B. Room Mockups.
C. Preconstruction Laboratory Mockups.

1.02 RELATED REQUIREMENTS

A. *Division 01 30 00* - Administrative Requirements.
B. *Division 01 40 00* - Quality Requirements: quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.

1.03 DEFINITIONS

A. Integrated Exterior Mockups: Free-standing mockups of the exterior envelope constructed on-site **as freestanding temporary built elements**, consisting of multiple products, assemblies, and subassemblies.
B. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site **as part of the permanent construction**, consisting of multiple products, assemblies, and subassemblies.
C. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting as indicated.
D. Preconstruction Laboratory Mockups: Integrated exterior mockups constructed at testing facility to verify performance characteristics.

1.04 REFERENCE STANDARDS

A. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.
B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
C. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift; 2018.
D. ASCE 7-16 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2016.
E. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
F. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
G. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).

H. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
I. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2010).
J. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.
K. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2017.
L. ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories; 2017.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings
1. Preinstallation Conference: Conduct conference at Project site. Allow for virtual attendance of Architect/Engineer and Owner while Contractor is on site.
a. Meet with Owner, Architect/Engineer, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior and interior mockups.
b. Review coordination of equipment and furnishings provided by the Owner for room mockups.
c. Review locations and extent of mockups.
d. Review testing procedures to be performed on mockups.
e. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and testing and maintain schedule for the Work.

1.06 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Action Submittals
1. Shop Drawings: For integrated exterior mockups, room mockups, and preconstruction laboratory mockups.
a. Include plans, elevations, sections, and mounting, attachment and support details.
b. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
c. Include site location drawing indicating orientation of mockup.
d. Revise and resubmit Shop Drawings to reflect approved modifications in details and component interfaces resulting from changes made during testing procedures.
2. Delegated Design Submittal: For temporary structural supports for mockups not attached to building structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
C. Informational Submittals:
1. Preconstruction Test Reports: For integrated exterior mockups.
2. Coordination Drawings: Provide documentation of mockup location and each sequential step for the dismantling, removal, repair and finish work specified.
a. Indicate on plans and elevations the location of each mockup specified.
b. Provide photos, sketches and other documentation of the entire process.
3. Qualification Data: For testing agency or Manufacturer's Technical Representative.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.
1. Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect/Engineer.
2. Accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.
B. Preconstruction Laboratory Mockup Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

C. Build mockups to do the following:
   1. Verify selections made under Sample submittals.
   2. Demonstrate aesthetic effects.
   3. Demonstrate the qualities of products and workmanship.
   4. Demonstrate acceptable coordination between components and systems.
   5. Perform preconstruction testing, such as window air-infiltration and water-infiltration testing.

D. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.
   1. Build mockups of size indicated.
   2. Build mockups in location indicated or, if not indicated, as directed by Architect/Engineer.
   3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
   4. Demonstrate the proposed range of aesthetic effects and workmanship.
   5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   6. Demolish and remove mockups when directed unless otherwise indicated.

E. Notifications:
   1. Notify Architect/Engineer fourteen (14) days in advance of the dates and times when mockups will be constructed.
   2. Notify Architect/Engineer fourteen (14) days in advance of the dates and times when mockups will be tested.
   3. Allow seven (7) days for initial review and each re-review of each mockup.

F. Approval: Obtain Owner's and Architect/Engineer's approval of mockups before starting fabrication or construction of corresponding Work.
   1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect/Engineer specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

B. Review: Mockups shall be planned according to one of the following parameters:
   1. All mockups are to be completed in stages, demonstrating the steps in the repair procedure.
   2. Date and Time:
      a. Mockups shall be ready for review during monthly site visit by Owner's Project Representative and Architect/Engineer.
      b. Architect/Engineer's review may be scheduled at times outside of the monthly site visit with approval of the Owner's Project Representative.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in *Division 01 40 00* - Quality Requirements, to design support structure for free-standing mockups.

B. Structural Performance:
   1. Seismic Performance: Mockups and support structure to withstand the effects of earthquake motions determined in accordance with ASCE 7-16.
   2. Wind Loads: As indicated on Structural Drawings.

C. Mockup Testing Performance Requirements: Perform tests using design pressures and performance criteria indicated for assemblies and products that are specified in other Sections and incorporated into integrated exterior mockups or preconstruction laboratory mockups.

2.02 INTEGRATED EXTERIOR MOCKUPS

A. Construct integrated exterior mockups according to approved mockup Shop Drawings or as indicated on Drawings. Construct mockups to demonstrate constructability, coordination of

trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.

B. Design and construct foundations and superstructure to support free-standing integrated exterior mockups.

C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.

D. Use specified products that have been approved by the Architect/Engineer. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.

E. The Work of integrated exterior mockups includes, but is not limited to, the following:
   1. Precast architectural concrete.
   2. Masonry Veneer.
   3. Stone cladding.
   4. Masonry (brick and stone) wall repairs.
   5. Brick and stone repointing.
   6. Cold-formed metal framing and sheathing.
   7. Air and weather barriers.
   8. Thermal insulation.
   9. Through-wall flashing.
   10. Flashing and sheet metal trim.
   11. Joint sealants.
   12. Metal wall panels.
   13. Aluminum-framed entrances and storefront.
   14. Glazed curtain walls.
   15. Aluminum windows.
   16. Glazing
   17. Hollow metal doors and frames.

F. Photographic Documentation: Document construction of integrated exterior mockups with photographs in accordance with Section 01 3000 - Administrative Requirements. Provide photographs showing details of interface of different materials and assemblies.
   1. Document testing procedures, including water leakage and other deficiencies. Photograph modifications to component interfaces intended to correct deficiencies.

G. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect/Engineer's approval for modifications.

H. Retain approved mockups constructed in place. Incorporate fully into the Work.

2.03 ROOM MOCKUPS

A. Build room mockups according to approved mockup Shop Drawings or as indicated on Drawings to evaluate constructability, demonstrate the coordination of trades and sequencing of Work, and to demonstrate aesthetic requirements. Include each visible finish, component, and equipment item within room mockups; include operable lighting.

B. Provide room mockups of the following rooms:
   1. Laboratory.
   2. Office.
   3. Toilet.
   4. Classroom.

C. The Work of room mockups includes, but is not limited to, the following:
   1. Millwork and casework.
   2. Doors and frames.
   3. Access doors and frames.
   4. Glazing.
   5. Metal framing.
   6. Gypsum board.
   7. Ceramic tiling.
   8. Acoustical ceilings.

9. Resilient flooring.
10. Painting.
11. Registers and grilles.
12. Wiring devices.
13. Lighting.

2.04 PRECONSTRUCTION LABORATORY MOCKUPS

A. Construct preconstruction laboratory mockups according to approved Shop Drawings or as indicated on Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements; and conduct performance testing indicated.

B. Build preconstruction laboratory mockups at testing agency facility using installers and construction methods that will be used at Project site.

C. Use specified products that have been approved by Architect/Engineer. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in preconstruction laboratory mockups.

D. The Work of preconstruction laboratory mockups includes, but is not limited to, the following:
   1. Precast architectural concrete.
   2. Masonry veneer.
   3. Stone cladding.
   4. Cold-formed metal framing and sheathing.
   5. Air and weather barriers.
   6. Thermal insulation.
   7. Through-wall flashing.
   8. Flashing and sheet metal trim.
   9. Joint sealants.
   10. Metal wall panels.
   11. Aluminum-framed entrances and storefront.
   12. Glazed curtain walls.
   13. Aluminum windows.
   14. Glazing.

E. Photographic Documentation: Document construction of preconstruction laboratory mockups with photographs in accordance with Section 01 3000 - Administrative Requirements. Provide photographs showing details of interface of different materials and assemblies.
   1. Document testing procedures, including water leakage and other deficiencies. Photograph modifications to component interfaces intended to correct deficiencies.

F. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect/Engineer's approval for modifications.

G. When testing is complete, remove test specimens and test assemblies, and preconstruction laboratory mockups; do not re-use products on Project.

PART 3 EXECUTION

3.01 TESTING OF INTEGRATED EXTERIOR MOCKUPS

A. Integrated Exterior Mockup Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
   1. Testing and inspecting agency will interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Integrated Exterior Mockup Testing Services: Perform the following tests in the following order:
   1. Water-Spray Test: Before installation of interior finishes has begun, test areas designated by Architect/Engineer in accordance with AAMA 501.2 for evidence of water penetration.
      a. Perform a minimum of three tests in areas as directed by Architect/Engineer.
   2. Air Leakage: Test in accordance with ASTM E783 at 1.5 times the rate specified in "Mockup Testing Performance Requirements" paragraph in "Performance Requirements" Article, but not more than 0.09 cfm/sq.ft. at a static-air-pressure differential of 1.57 lbf/ sq.ft..
      a. Perform a minimum of three tests in areas as directed by Architect/Engineer.
   3. Water Penetration: Test in accordance with ASTM E1105 at a minimum uniform and cyclic

static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Mockup Testing Performance Requirements" paragraph in "Performance Requirements" Article, but not less than 6.24 ibf/sq.ft. (300 Pa), and verify no evidence of water penetration.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections, and also to observe testing for the following systems and assemblies.
   1. Joint sealants specified in Section 07 9200 - Joint Sealants.
   2. Curtain wall specified in Section 08 4413 - Glazed Aluminum Curtain Walls.
D. Integrated exterior mockups will be considered defective if it does not pass tests and inspections.
E. Prepare test and inspection reports.

3.02 TESTING OF PRECONSTRUCTION LABORATORY MOCKUPS

1. Testing and inspecting agency will interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Testing Criteria: Where the following tests are indicated, use criteria indicated.
   1. Air Leakage in accordance with ASTM E283: Static-air-pressure differential of 1.57 lbf/sq.ft.
   2. Water Penetration in accordance with ASTM E331: Minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq.ft.
C. Unlock, open, and relock operable windows and doors five times. Perform necessary hardware adjustments, if any, and repeat cycling.
D. Preconstruction Laboratory Mockup Testing: Perform the following tests in the following order.
   1. Structural, 50 Percent: ASTM E330/E330M at 50 percent of positive test load for not less than 10 seconds.
   2. Air Leakage: ASTM E283.
   3. Water Penetration under Static Pressure: ASTM E331.
   4. Water Penetration under Dynamic Pressure: AAMA 501.1 at minimum air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq.ft.
   5. Interstorey Drift: AAMA 501.4 at 100 percent of design displacement. Repeat the following:
      a. Air Leakage: ASTM E283.
      b. Water Penetration under Static Pressure: ASTM E331.
   6. Vertical Interstorey Movement: AAMA 501.7 at 100 percent of design displacement. Repeat the following:
      a. Air Leakage: ASTM E283.
      b. Water Penetration under Static Pressure: ASTM E331.
   7. Thermal Cycling: AAMA 501.5. Repeat the following:
      a. Air Leakage: ASTM E283.
      b. Water Penetration under Static Pressure: ASTM E331.
   8. Structural, 100 Percent: ASTM E330/E330M at 100 percent of positive and negative test loads for not less than 10 seconds. Repeat the following:
      a. Air Leakage: ASTM E283.
      b. Water Penetration under Static Pressure: ASTM E331.
      c. Water Penetration under Dynamic Pressure: AAMA 501.1.
   9. Structural, 150 Percent: ASTM E330/E330M at 150 percent of positive and negative test loads for not less than 10 seconds.
   10. Interstorey Drift: AAMA 501.4 at 150 percent of design displacement.
E. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections, and also to observe testing for the following systems and assemblies.
   1. Curtain wall specified in Section 08 4413 - Glazed Aluminum Curtain Wall.
   2. Aluminum windows specified in Section 08 5113 - Aluminum Windows.
F. Preconstruction laboratory mockups will be considered defective if it does not pass tests and inspections.
G. Prepare test and inspection reports.

DIVISION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities.
B. Temporary telecommunications services.
C. Temporary sanitary facilities.
D. Temporary Controls: Barriers, enclosures, and fencing.
E. Security requirements.
F. Vehicular access and parking.
G. Waste removal facilities and services.
H. Field offices.

1.02 RELATED REQUIREMENTS

A. *Division 01 58 13* - Temporary Project Signage.
B. *Division 01 70 00* - Execution and Closeout Requirements.

1.03 TEMPORARY UTILITIES

A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.

1.04 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
B. Telecommunications services shall include:
    1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
    2. Telephone Land Lines: One line, minimum; one handset per line.
    3. Internet Connections: Minimum of one; DSL modem or faster.
    4. Email: Account/address reserved for project use.
    5. Facsimile Service: Minimum of one dedicated fax/printer, with dedicated phone line.

1.05 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
B. Maintain daily in clean and sanitary condition.

1.06 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
B. Provide protection for plants designated to remain. Replace damaged plants.
C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07 FENCING

A. Construction: Commercial grade chain link fence.
B. Provide 6-foot-high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.08 SECURITY

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
B. Coordinate with Owner's security program.

1.09 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
B. Coordinate access and haul routes with governing authorities and Owner.
C. Provide and maintain access to fire hydrants, free of obstructions.
D. Provide means of removing mud from vehicle wheels before entering streets.
E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.10 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site weekly.
C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.11 FIELD OFFICES

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
B. Provide space for Project meetings, with table and chairs to accommodate 10 persons.
C. Locate offices a minimum distance of 30 feet from existing and new structures.

1.12 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
C. Clean and repair damage caused by installation or use of temporary work.

DIVISION 01 58 13 – TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project identification sign.
B. Project informational signs.

1.02 RELATED REQUIREMENTS

A. *Division 01 22 00* - Allowances: Graphic Image cash allowance.

1.03 REFERENCE STANDARDS

A. FHWA (SHS) - Standard Highway Signs and Markings; 2004, with Supplement (2012).

1.04 QUALITY ASSURANCE

A. Design sign and structure to withstand 50 miles/hr wind velocity.
B. Sign Painter: Experienced as a professional sign painter for minimum three years.
C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

PART 2 PRODUCTS

2.01 SIGN MATERIALS

A. Structure and Framing: New, wood, structurally adequate.
B. Sign Surfaces: Exterior grade plywood with medium density overlay (MDO), minimum 3/4-inch thick, standard large sizes to minimize joints.
C. Rough Hardware: Galvanized.
D. Paint and Primers: Exterior quality, two coats; all sign background surfaces and supports to be white color.
E. Lettering: Exterior quality paint, contrasting colors.
F. Lettering: Pre-cut vinyl self-adhesive products, white.
G. Graphic Image: Design by Architect/Engineer.

2.02 PROJECT IDENTIFICATION SIGN

A. Contractor shall provide one painted sign surface, 4' high x 8' long x 3/4" thick exterior grade plywood with medium density overlay (MDO), with two painted 4x4x12' pressure treated wood post supports and associated fasteners for attaching sign surface to posts. Posts to be parallel to 4' high dimensions of sign surface. Bottom of sign surface to be maximum 5'-0" above finished grade. Install sign at location indicated on drawings.
B. Graphic Image, 4' high x 8' long, design, artwork, colors, style of lettering are designated by Architect/Engineer and will be printed on vinyl similar to 3M 180C control tac vinyl with UV inks. The Contractor will mount the UV vinyl on the sign surface MDO board and wrap the edges with vinyl. Architect/Engineer will email a print ready PDF to the Contractor for his use in purchasing

the Graphic Image as stated in 01 2100 - Allowances.

2.03 PROJECT INFORMATIONAL SIGNS

A. Painted informational signs of same colors and lettering as Project Identification sign, or standard products; size lettering to provide legibility at 100-foot distance.
B. Provide at each field office, storage shed , and directional signs to direct traffic into and within site. Relocate as Work progress requires.
C. Provide municipal traffic agency directional traffic signs to and within site.

2.04 SIGNS, SIGNALS, AND DEVICES

A. Stock Post Mounted and Wall Mounted Traffic Control and Informational Signs:
   1. Products:
      a. Brimar Industries, Inc.: www.safetysign.com/#sle.
      b. Substitutions: See *Division 01 60 00* - Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
B. Erect at designated location.
C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
D. Install sign surface plumb and level, with butt joints. Anchor securely.
E. Paint exposed surfaces of sign, supports, and framing.

3.02 MAINTENANCE

A. Maintain signs and support cleaning, repair deterioration and damage.

3.03 REMOVAL

A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

DIVISION 01 60 00 – PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.
B. Transportation, handling, storage and protection.
C. Product option requirements.
D. Substitution limitations.
E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. *Division 01 25 00* - Substitution Procedures: Substitutions made during procurement and/or construction phases.
B. *Division 01 40 00* - Quality Requirements: Product quality monitoring.

1.03 REFERENCE STANDARDS

A. 16 CFR 260.13 - Guides for the Use of Environmental Marketing Claims; Federal Trade Commission; Recycled Content; Current Edition.
B. ASTM D6866 - Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis; 2020.
C. CAN/CSA Z809 - National Standard for Sustainable Forest Management; CSA International Inc.; 2016.

1.04 SUBMITTALS

A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
   1. Submit within 15 days after date of Agreement.
   2. For products specified only by reference standards, list applicable reference standards.
B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
C. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
D. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral

parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

1.05 QUALITY ASSURANCE

A. Material and equipment incorporated into the Work:
   1. Conform to applicable specifications and standards.
   2. Comply with size, make, type, and quality specified, or as specifically approved in writing by the Architect/Engineer.
   3. Manufactured and Fabricated Products:
      a. Design, fabricate, and assemble in accord with the best engineering and shop practices.
      b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
      c. Two or more items of the same kind shall be identical, by the same manufacturer.
      d. Products shall be suitable for service conditions.
      e. Equipment capacities, sizes, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
   4. Do not use material or equipment for any purpose other than that for which it is designated or is specified.

B. Manufacturers' Instructions:
   1. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in installation, including copies to Architect/Engineer and Contractor. Maintain one (1) set of complete instructions at the job site during installation and until completion.
   2. Handle, install, connect, clean, condition and adjust products in strict accordance with such instructions and in conformance with specified requirements.
   3. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Architect for further instructions. Do not proceed with work without clear instructions.
   4. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents, or Architect's written instructions.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. Use of products having any of the following characteristics is not permitted:
   1. Made outside the United States, its territories, Canada, or Mexico.
   2. Made using or containing CFC's or HCFC's.
   3. Made of wood from newly cut old growth timber.
   4. Containing lead, cadmium, or asbestos.

C. Provide interchangeable components of the same manufacture for components being replaced.

2.02 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver and place in location as directed; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See *Division 01 25 00* - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
D. Transport and handle products in accordance with manufacturer's instructions.
E. Transport materials in covered trucks to prevent contamination of products and littering of surrounding areas.
F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed conveniently to work area in order to minimize waste due to excessive materials handling and misapplication.
B. Store and protect products in accordance with manufacturers' instructions.
C. Store with seals and labels intact and legible.
D. Store sensitive products in weather tight, climate-controlled enclosures in an environment favorable to product.
E. For exterior storage of fabricated products, place on sloped supports above ground.
F. Provide off-site storage and protection when site does not permit on-site storage or protection.
G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
H. Comply with manufacturer's warranty conditions, if any.
I. Do not store products directly on the ground.
J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
L. Prevent contact with material that may cause corrosion, discoloration, or staining.
M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
N. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

DIVISION 01 61 16 - VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements for Indoor-Emissions-Restricted products.
B. Requirements for VOC-Content-Restricted products.

1.02 RELATED REQUIREMENTS

A. *Division 01 30 00* - Administrative Requirements: Submittal procedures.
B. *Division 01 40 00* - Quality Requirements: Procedures for testing and certifications.
C. *Division 01 60 00* - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.
D. *Division 07 92 00* - Joint Sealants: Emissions-compliant sealants.
E. *Division 09 65 00* - Resilient Flooring.
F. *Division 09 68 00* - Tile Carpeting.
G. *Division 09 90 00* - Painting and Coating.

1.03 DEFINITIONS

A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings applied on site.
   2. Interior adhesives and sealants applied on site, including flooring adhesives.
   3. Flooring.
   4. Composite wood.
   5. Products making up wall and ceiling assemblies.
   6. Thermal and acoustical insulation.
   7. Other products when specifically stated in the specifications.

B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
   1. Exterior and interior paints and coatings.
   2. Interior adhesives and sealants, including flooring adhesives.
   3. Wet-applied roofing and waterproofing.
   4. Interior - Carpet.
   5. Interior - Flooring Material.
   6. Other products when specifically stated in the specifications.

C. Interior of Building: Anywhere inside the exterior weather barrier.

D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.

E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
   1. Stone.
   2. Concrete.
   3. Clay brick.
   4. Metals that are plated, anodized, or powder-coated.
   5. Glass.
   6. Ceramics.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2018).

C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; 2017, v1.2.

D. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; Current Edition.

E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.

F. CHPS (HPPD) - High Performance Products Database; Current Edition.

G. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.

H. GreenSeal GS-36 - Standard for Adhesives for Commercial Use; 2013, with Editorial Revision (2024).

I. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

J. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).

K. SCS (CPD) - SCS Certified Products; Current Edition.

L. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

1.06 QUALITY ASSURANCE

A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
   1. Wet-Applied Products: State amount applied in mass per surface area.
   2. Paints and Coatings: Test tinted products, not just tinting bases.
   3. Evidence of Compliance: Acceptable types of evidence are the following;
      a. Current UL (GGG) certification.
      b. Current SCS (CPD) Floorscore certification.
      c. Current SCS (CPD) Indoor Advantage Gold certification.
      d. Current listing in CHPS (HPPD) as a low-emitting product.
      e. Current CRI (GLP) certification.
      f. Test report showing compliance and stating exposure scenario used.
   4. Product data submittal showing VOC content is NOT acceptable evidence.
   5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.

B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Report of laboratory testing performed in accordance with requirements.
      b. Published product data showing compliance with requirements.
      c. Certification by manufacturer that the product complies with requirements.

C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Current SCS "No Added Formaldehyde (NAF)" certification; www.scscertified.com.
      b. Report of laboratory testing performed in accordance with requirements.
      c. Published product data showing compliance with requirements.
      d. Certification by manufacturer that the product complies with requirements.

D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.01 MATERIALS

A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.

B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
   1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
   2. Inherently Non-Emitting Materials.

C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
   1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
   2. Aerosol Adhesives: GreenSeal GS-36.
   3. Joint Sealants: SCAQMD 1168 Rule.
   4. Paints and Coatings: Each color; most stringent of the following:
      a. 40 CFR 59, Subpart D.
      b. SCAQMD 1113 Rule.
      c. CARB (SCM).
   5. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.

B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

DIVISION 01 70 00 – EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project Record Documents.
B. Operation and Maintenance Data.
C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. *Division 01 30 00* - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
B. *Division 01 70 00* - Execution and Closeout Requirements: Contract closeout procedures.
C. Individual Product Sections: Specific requirements for operation and maintenance data.
D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect/Engineer with claim for final Application for Payment.
B. Operation and Maintenance Data:
   1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.
   2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of all documents sets as required prior to final submission.
   4. Submit two sets of revised final documents in final form within 10 days after final inspection.
C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.
B. Ensure entries are complete and accurate, enabling future reference by Owner.
C. Store record documents separate from documents used for construction.
D. Record information concurrent with construction progress.
E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.
F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction,

referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.
B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
D. Additional information as specified in individual product specification sections.
E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.
B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
D. Include color coded wiring diagrams as installed.
E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.
F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
G. Provide servicing and lubrication schedule, and list of lubricants required.
H. Include manufacturer's printed operation and maintenance instructions.
I. Include sequence of operation by controls manufacturer.
J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
K. Provide control diagrams by controls manufacturer as installed.
L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

O. Include test and balancing reports.
P. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
C. Binders: Commercial quality, 8-1/2 by 11-inch three D side ring binders with durable plastic covers; 2-inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect/Engineer, Consultants, Contractor and subcontractors, suppliers and vendors, with names of responsible parties.
F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab includes a description of product and major component parts of equipment.
H. Text: Manufacturer's printed data, or typewritten data on 20-pound paper.
I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
J. Arrangement of Contents: Organize each volume in parts as follows:
    1. Project Directory.
    2. Table of Contents, of all volumes, and of this volume.
    3. Operation and Maintenance Data: Arranged by system, then by product category.
        a. Source data.
        b. Product data, shop drawings, and other submittals.
        c. Operation and maintenance data.
        d. Field quality control data.
        e. Photocopies of warranties and bonds.
    4. Design Data: To allow for addition of design data furnished by Architect/Engineer or others, provide a tab labeled "Design Data" and provide a binder large enough to allow for insertion of at least 20 pages of typed text.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
B. Verify that documents are in proper form, contain full information, and are notarized.
C. Co-execute submittals when required.
D. Retain warranties and bonds until time specified for submittal.
E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.
F. Manual: Bind in commercial quality 8-1/2 by 11-inch three D side ring binders with durable plastic covers.
G. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
H. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
I. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier,

and manufacturer, with name, address, and telephone number of responsible principals.

DIVISION 01 78 00 - SPECIAL WARRANTIES AND MAINTENANCE AGREEMENTS

GENERAL

SPECIAL WARRANTIES: All work shall be fully warranted for one year, unless otherwise noted, from the date of substantial completion by the contractor who shall replace any defective materials and repair any defective workmanship. Mechanical contractors are responsible for maintaining the entire system within the first year of warranty including flushing strainers, clean out and flush equipment and piping systems as required, cleaning drain pans, cleaning the coils, washing the coils including condenser coils, changing filters and any other equipment IOM maintenance recommendation. Contractor shall respond within 2 hours of notification. In addition, written warranties shall be provided for the following products and time periods. These warranties shall include any material and labor costs to repair defective materials and correct defective workmanship.

Product	Required Warranty Period Soil Termiticide Treatment
5-years	
Wood Doors	Lifetime warranty after installation
Carpet	15-years minimum
Theater Seating	5-year minimum
Metal Panel Systems	20-year paint warranty minimum Marker Board Writing Surface Lifetime warranty after installation
Fully adhered EPDM Roof	20-year, No Dollar Limit, Full system warranty, & 5-year Contractor labor warranty minimum
Stadium Lighting	25-year, No-Touch warranty

ROOF INSULATION: Warranty states that roof insulation's actual thermal resistance will not vary from the aged R-Value for a period of fifteen (15) years.

MAINTENANCE AGREEMENT: Designer shall include in project documents direction for the HVAC contractor to provide a complete one-year maintenance agreement for the HVAC system as described below for the first year. Specify an Add Alternate to continue maintenance agreement for two years:

- Answer all maintenance calls by MSCS within 2 hours
- All lubrication of equipment as recommended by the manufacturer.
- Replace all drive belts as required.
- HVAC contractor shall provide filter changes every 30 days for 6 months and twice in second half of year.
- Clean out and flush equipment and piping systems as required.
- Readjust all equipment as required to maintain comfort conditions.
- *Monitor system and Alarms using a remote web-based PC / Computer utilizing the Stand Alone BACnet DDC system software via the Building Edge Device, if BAS is included in the scope of work.*
- Product Maintenance Instructions. Must follow closeout OEM.

DIVISION 01 79 00 - PROJECT CLOSE-OUT

GENERAL

OPERATION AND MAINTENANCE MANUALS: Two (2) hard copies and one (1) electronic set via electronic transfer device, i.e. flash drive, of all operation and maintenance manuals shall be delivered by the Contractors to the Owner through the Designer at the Final Completion Inspection. The Index for Close Out Documents shall be included in the Front-End Document to be provided to the Designer. Documents are only acceptable via the provided index. The Designer shall receive and review the Close Out Documents provided by the Contractor and validate that all the required information is included.
See subsequent Sections for additional specific requirements.

FINAL INSPECTION: Each project shall have both Substantial Completion and Final Completion inspections made before it is finally accepted by the Owner. Two complete and thorough training sessions shall be conducted by the contractors and all the subcontractors for the MSCS Maintenance Department, one for winter operation and one for summer operation in each of the first seasons. The first training shall take place on site after the Substantial Completion inspection. A written record of this training and those in attendance shall be

made and sent to the Owner and Contractor.
The Substantial Completion inspection shall be held after contractor requests in writing when the building can be used for its intended purpose. At Substantial Completion all systems are in to be place and in operation and Commissioning (when required) or Pre-Functional Testing reports will be available. The Director of Major Construction shall be notified in writing of this inspection and shall take possession of the above-mentioned Operation and Maintenance Manuals. The HVAC contractor shall demonstrate to the Owner and Designer that all systems in the building are properly installed, balanced, and perform as designed and specified. All Contractors and Subcontractors shall attend this inspection including the HVAC, air and water balance subcontractor. The Designer will generate a punch list from this Substantial Completion inspection and distribute it to the Owner and Contractor.

The Final Completion inspection shall be held with the Owner, Designer, and all Contractors to demonstrate to the Owner that all systems in the building are operating as designed and to their satisfaction and that all punch list items are completed. A record of this inspection and those in attendance shall be made and sent to the Owner and Contractor.

WARRANTY INSPECTION: One post construction inspection shall be held by the Designer with the Contractor and Owner to assure that the building is continuing to operate in accordance with the plans and specifications and that no unusual problems are occurring in the building systems. The post construction inspection shall be held prior to expiration of the 1-year warranty period. It shall address general construction as well as plumbing, HVAC and electrical work. All problems discovered during these inspections that relate to defective materials or defective workmanship shall be corrected by the Contractor at no additional cost to the Owner.
RECORD DRAWINGS (AS-BUILTS): The Designer shall specify that during construction operations the Contractor shall faithfully record all changes to the contract documents, including accurate dimensions where applicable including invert elevations for all below-grade outside utilities with reference to permanent above-grade objects as well as changes to the Specifications including changes in materials actually installed versus those specified.

The Designer shall also specify that at completion of the work all such changes shall be recorded neatly with red ink by the contractor on an unused set of the contract drawing prints supplied by the Designer. The red line change shall be reviewed by the Designer who shall modify all contract drawings to reflect and incorporate all field changes as well as ASI, RFI responses, and other contract modifications.
SUBSTANTIAL COMPLETION: Substantial Completion is the date that the Owner and Designer determine the project is complete enough to be used for its intended purpose. It is also the date that the warranty periods begin.

FINAL COMPLETION: Designer to include MSCS close out document index and designer to validate all items are included in the close out document submittal.

DIVISION 01 80 00 – MINIMUM OWNER TRAINING REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. This section is intended to clearly define the requirements for Owner Training. If other sections within the contract documents contain owner training requirements, the most stringent requirements shall supersede.
B. The term “Owner Training” shall encompass both “demonstration” and “training” as outlined in this specification section and throughout the project.
C. The Commissioning Agent will be responsible for reviewing and approving all Owner Training for commissioned systems. Non-commissioned systems will be reviewed and approved by the Architect/Engineer.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.3 GENERAL

A. The GC/CM shall coordinate the Owner Training. Owner Training shall be completed according to the requirements outlined within this and other specification sections within the contract documents.

1.4 APPLICABLE EQUIPMENT AND SYSTEMS

A. At a minimum, Contractor shall provide training on all systems including, but not limited to, the following (as applicable to the Project):
   1. Heating, Ventilating and Air Conditioning equipment
   2. Building Automation System
   3. Electrical System; including Normal Power service and distribution equipment as well as interior and exterior lighting and associated controls
   4. Pluming System; including Water Heaters, Circulation Pumps, Plumbing Fixtures, Natural Gas, etc.

1.5 SUBMITTALS

A. Training Plan: At least 30 days prior to the start of Owner Training, the GC/CM shall provide the training plan to the Architect, Owner and Commissioning Agent for review and approval. The GC/CM shall revise and resubmit it until acceptable. The Training Plan shall include the following at a minimum:
   1. Overall schedule showing all Owner Training sessions.
   2. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. List of all subjects to be covered. See training session requirements located in *Division 01 80 00*
      d. Name of firm and person conducting training; include qualifications.
      e. Intended audience, such as job description.
      f. Objectives of training and suggested methods of ensuring adequate training.
      g. Methods to be used, such as classroom lectures, live demonstrations, hands-on, etc.
      h. Media to be used, such as slides, hand-outs, etc.
      i. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
      j. Sample attendance record.
      k. Sample Owner Training Evaluation Forms. Custom forms shall be created for each equipment system to ensure key learning objectives have been achieved.

B. Training Manuals: The GC/CM shall provide a training manual for each attendee; allow for minimum of two (2) attendees per training session.
   1. Include applicable portions of O&M manuals.
   2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
   3. Provide one (1) extra copy of each training manual to be included with operation and maintenance data.

C. Scheduling – The GC/CM shall coordinate with the Architect, Owner and Commissioning Agent on the date(s) of Owner Training and shall provide at least 14 days' notice prior to training.

D. Training Reports:
   1. Identification of each training session, date, time, and duration.
   2. Sign-in sheet showing names and job titles of attendees.
   3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
   4. Completed Owner Training Evaluation Forms.

E. Video Recordings: Submit digital video recording of all Owner Training for Owner's subsequent use.
   1. Format: DVD Disc and Electronic Format.
   2. Label each disc and container with session identification and date.
   3. Training video shall be broken up, edited, and labeled for each piece of equipment and/or training session.

4. Electronic Copies shall be included in the Close-Out documentation.

1.6 QUALITY ASSURANCE

A. Instructor Qualifications: Factory authorized and trained individual who is familiar with the design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
   2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner and Commissioning Agent and satisfy all other requirements of this specification.
B. Demonstrations conducted during Functional Performance Testing need not be repeated unless Owner personnel require additional information.
C. Demonstrations may be combined with training sessions if applicable.
D. Dynamic Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
   1. Perform demonstrations not less than two (2) weeks prior to Substantial Completion.
   2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six (6) months.
E. Static Equipment or Systems: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
   1. Perform demonstrations not less than two (2) weeks prior to Substantial Completion.

3.2 TRAINING - GENERAL

A. GC/CM will prepare the Training Plan based on draft plans submitted.
B. Conduct Owner Training on-site unless otherwise indicated.
C. Owner will provide classroom and seating at no cost to Contractor.
D. Where applicable, do not start Owner Training until Functional Performance Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
E. Each training session shall cover the following topics at a minimum:
   1. Basis of Design and Operational Requirements including but not limited to:
      a. General systems and equipment description and function
      b. Performance and design criteria
      c. Operational parameters including setpoints, schedules, etc.
      d. Limiting conditions include safeties, interlocks, alarms, etc.
      e. Location of all control devices including sensors, actuators, controllers, etc.
   2. Review of project documents including but not limited to:
      a. Location of turnover documents within the facility
      b. Location of equipment and systems within facility
      c. As-Built project record drawings
      d. O&M Manuals
      e. Recommended maintenance forms and checklists
      f. Troubleshooting guides and decision trees
      g. Warranty information and maintenance agreements
   3. Normal Operation
      a. Startup process and procedures
      b. Normal shutdown process and procedures
      c. Normal operating instructions
      d. As-built control sequences for all modes of operation
      e. As-built setpoints and schedules
      f. Safety procedures
      g. Seasonal, weekend and holiday operating instructions
   4. Emergency Operation

a. Explanation of warnings, alarms, trouble indicators and error messages
b. Emergency shutdown process and procedures
c. Non-normal operation instructions for operating outside normal limits, including failure of components, sensors or subsystems
d. Safety procedures

5. Maintenance and Adjustments
   a. Alignments and adjustments
   b. Noise and vibration
   c. Routine cleaning and inspections, including frequency, materials and tools required
   d. Preventative maintenance activities and frequency, including checklists, materials and tools required
6. Troubleshooting and Repairs
   a. Identification and diagnostic instructions
   b. Test and inspection procedures
   c. Disassembly instructions, including removal and replacement
   d. Repair instructions
   e. Identification of parts and components
   f. Review of attic stock and recommended spare parts

3.3 MINIMUM TRAINING HOURS

A. The total minimum owner training hours required for each system/equipment are identified below. If the contractor believes hours are insufficient, additional time shall be included in the project to ensure sufficient understanding of all operation and maintenance requirements of equipment and systems.

EQUIPMENT/SYSTEM TYPE	SPECIFICATION DIVISION	MIN. TRAINING HOURS
HVAC SYSTEMS		
Building Automation System	23 09 23	16
Packaged Rooftop Unit	23 60 00	3
Dedicated Outdoor Air Unit	23 79 00	3
Make-up Air Unit	23 70 00	1
Split Systems Air Conditioners	23 82 00	1
Variable Air Volume Terminal Unit	23 36 00	.5
Exhaust Fan	23 34 00	1
PLUMBING SYSTEMS		
Domestic Water Heater	22 30 00 / 22 42 00	1
Circulation Pump	22 30 00 / 22 42 00	.5
Thermostatic Mixing Valves	22 30 00	.5
Plumbing Fixture Controls	22 42 00	.5
ELECTRICAL SYSTEMS		
Switchboards and Panelboards	26 05 40	1
Transformers	26 09 10	1
Disconnects	26 10 20	.5
Interior Lighting Controls Devices	26 50 10	4
Exterior Lighting Controls Devices	26 50 20	4
Lighting Controls System	26 50 00	1

3.4 SCHEDULING

A. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

B. No single training session may last more than 90 minutes without a minimum of a 15-minute break between sessions.
C. No more than seven (7) hours of training may be completed in a single day.
D. Total training hours identified above are intended to be utilized throughout the one-year warranty period as outlined below. Contractor shall plan training time according to enable onsite support at a minimum of each point:
    1. Initial owner training at turnover.
    2. Three to six (3-6) months after turnover or at first major preventative maintenance cycle to answer questions and re-train on specific items as necessary.
    3. Participate at the 10-month warranty review or prior to completion of the 1-year warranty to answer any remaining questions and ensure sufficient knowledge on operation of equipment.

3.5 VIDEO RECORDING

A. Video recording of all Owner Training shall comply with the following requirements:
    1. Video recording shall be done on a device specifically intended for this purpose. Tripods or other stabilizing devices shall be used to ensure a stable, high quality video.
    2. Remote microphones shall be utilized to ensure high quality audio and understanding of trainer.
    3. Ensure sufficient lighting is provided to observe instructor and all components being trained on.
B. Any of the following will result in rejection of the training video and require re-training at no additional cost to the owner or count against the minimum hours listed above:
    1. Use of cellular phones or tablets for recording device.
    2. Use of video cameras without tripods or other stabilizing devices.
    3. Poor audio quality due to not using remote microphones or excessive ambient noise.
    4. Poor lighting resulting in inability to clearly see equipment or components.

3.6 TRAINING ACCEPTANCE

A. The Commissioning Agent and/or Architect will review all Owner Training with the Owner's operating personnel and determine if training provided was satisfactory. If training is determined to be insufficient to ensure proper operation and maintenance, additional training will be provided by the contractor a no cost to the owner.
B. Training will not be deemed acceptable until the following have been completed:
    1. Training plan has been approved.
    2. All required turnover documents have been received (O&M Manuals, As-Builts, etc.)
    3. Training manuals have been approved.
    4. Training reports have been approved.
    5. Video Recordings have been approved.
    6. Owner competence has been confirmed.

DIVISION 01 81 13 - ENERGY CONSERVATION

GENERAL

Energy Conservation is of the utmost importance for all MSCS projects. Consideration of all new materials and equipment should be discussed for all new construction and major renovations with the goal of providing the most energy efficient building possible within the budget constraints.

The Design Team shall make every effort to provide a system design with maximum utilization of energy conservation measures, consistent with functional requirements of the building. Close coordination between the Mechanical Engineer, Electrical Engineer and Architect in the best interest of energy conservation shall be required.

The following design items shall be performed by or complied with the Design Teams for all work, both new and renovation:

- Review building envelope insulation strategies with the MSCS DoMC during design development phase. Insulation levels shall be maximized to enhance long term benefits and comfort and as required by the current adopted building codes. Considerable care shall be taken to minimize infiltration through the building envelope. Major areas of concern are windows, ceiling/roof assemblies, roof penetrations,

entry areas and the air space in the exterior wall assembly where insulation shall be continuous to create an envelope without joints. All exterior walls shall have vapor barriers (sprayed-on preferred; nailed and taped also acceptable).

- Natural daylighting shall be thoroughly examined and used in all spaces where possible and practical.
- Specify water savings features on all water consuming devices. Drinking fountains shall have bottle fillers with electronic readout indicating ounces filled.

DIVISION 01 90 00 – GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL – 100% Commissioning required.

1.1 SUMMARY

A. The work under this Section is subject to requirements of the Contract Documents including the Owner's General Conditions and articles of the Construction Manager's General Conditions.

B. General Commissioning of the project will be executed outside of the general contract by an independent consultant to the A/E. This document states the requirements of the Construction Manager/General contractor to assist the Commissioning Agent in the execution of his work.

C. Commissioning shall be performed in accordance with the requirements of the Commissioning Standard under which the Commissioning Firm's qualifications are approved or identified within this specification. All quality assurance provisions of the Commissioning Standard such as performance guarantees shall be part of this contract. Commissioning procedures shall be developed by the Commissioning Agent and be in accordance with Commissioning Scope of Work. Where new procedures, requirements, etc. applicable to the Contract requirements have been published or adopted by the body responsible for the Commissioning Standard used (ACG, NEBB, or TABB), the requirements and recommendations in these procedures and requirements shall be considered mandatory.

D. The commissioning process does not reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product in accordance with the Contract Documents.

E. This section shall in no way diminish the responsibility of *Division 07, 22, 23, and 26* Contractors, Subs and Suppliers in performing all aspects of work and testing as outlined in the contract documents. Any requirements outlined in this section are in addition to requirements outlined in Division 07, 22, 23, and 26 Specifications.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

B. The requirements in this section are in addition to those specifically outlined in:

1. *Division 01 80 00* – Minimum Owner Training Requirements
2. *Division 07 08 00* – Commissioning of Building Envelope
3. *Division 22 08 00* – Commissioning of Plumbing Systems
4. *Division 23 08 00* – Commissioning of HVAC Systems
5. *Division 26 08 00* – Commissioning of Electrical Systems

1.3 EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

A. Commissioning will be performed for the following systems and equipment:

1. Building Envelope; including thermal, air and vapor barriers
2. HVAC Systems and controls; including air and water side equipment
3. Plumbing Systems; including domestic hot water and plumbing fixture controls
4. Electrical Systems; including normal power distribution (through first 480v distribution board, exterior lighting controls and interior lighting controls

1.4 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designations only.

1. ASHRAE Guideline 1.1 – HVAC&R Technical Process for the Commissioning Process (2007)
2. ASHRAE Guideline 0 – The Commissioning Process (2005)
3. ACG Commissioning Guideline – ACG Commissioning Guideline (2005)
4. NEBB Commissioning Standard – Whole Building Technical Commissioning of New Construction (2019)

5. SMACNA 1429 – HVAC Systems Commissioning Manual, 1st Edition (1994)
6. ANSI/NETA – Standard For Electrical Commissioning of Electrical Power Equipment and Systems (2015)
7. NIBS Guideline 3 – Building Enclosure Commissioning (2012)

1.5 DEFINITIONS & ABBREVIATIONS

A. A/E: Architect/Engineer
B. Acceptance Phase: Phase of construction after startup and initial checkout when Functional Performance Testing, O&M documentation review and training occurs.
C. Air Barrier Accessory: Products designated to maintain air tightness between air barrier materials, air barrier assemblies and air barrier components, to fasten them to the structure of the building, or both (e.g., sealants, tapes, backer rods, transition membranes, fasteners, strapping, primers).
D. Air Barrier Assembly: The combination of air barrier materials and air barrier accessories that are designated and designed within the environmental separator to act as a continuous barrier to the movement of air through the environmental separator.
E. Air Barrier Component: Pre-manufactured elements such as windows, doors, dampers, and service elements that are installed in the environmental separator.
F. Air Barrier Envelope: The combination of air barrier assemblies and air barrier components, connected by air barrier accessories that are designed to provide a continuous barrier to the movement of air through an environmental separator. There may be more than one air barrier envelope in a single building. Also known as Air Barrier System.
G. Air Barrier Material: A building material that is designed and constructed to provide the primary resistance to airflow through an air barrier assembly.
H. Air Leakage Rate: The rate of airflow (CFM) driven through a unit surface area (sq.ft.) of an assembly or system by a unit static pressure difference (Pa) across the assembly (example: 0.25 CFM/sq.ft. @ 75 Pa).
I. Air Leakage: The total airflow (CFM) driven through the air barrier system by a unit static pressure difference (Pa) across the air barrier envelope (example:6500 CFM @ 75 Pa).
J. Air Permeance: The rate of airflow (CFM) through a unit area (sq.ft.) of a material driven by unit static pressure difference (Pa) across the material (example: 0.004CFM/sq.ft. @ 75 Pa).
K. BAS: Building Automation System
L. Basis of Design (BOD): The Engineer's Basis of Design is comprised of two components: The Design Criteria and Design Narrative. These documents record the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines.
M. CC: Controls Contractor
N. Certificate of Readiness (COR): The COR is a document produced by the GC/CM and submitted to the CxA that states specifically indicated systems or equipment are complete installed, started up, have undergone all testing and checkout and are ready to schedule FPTs.
O. Commissioning Agent (CxA): An independent party, not otherwise associated with the A/E team members or the GC/CM oversees, though he/she may be hired as a subcontractor to them. The CxA directs the day-to-day commissioning activities.
P. Commissioning Issue (Cx Issue): Any component or system condition (static or dynamic) that is in non-conformance with the contract documents, commissioning documents, performance requirements and/or industry standards and adversely affects the commissionability, operability, maintainability, or functionality of a system equipment or components.
Q. Commissioning Issues log: A formal and ongoing record of Commissioning Issues or concerns and their resolution that have been raised by members of the Commissioning Team during the commissioning process. Also known as the Corrective Action Log (CAL).
R. Commissioning Plan (Cx Plan): An overall document that provides the structure, schedule and coordination planning for the commissioning process. The Cx Plan identifies the project's commissioning goals, commissioning team members and their roles; establishes the scope of commissioning in terms of systems and equipment; and outlines the major commissioning steps during design, construction, acceptance and occupancy phases. The Cx Plan outlines the expectations of the Contractor's organization, scheduling, allocation of resources, documentation, etc., pertaining to the overall commissioning process.

S. Commissioning Final Report: The final document which presents the commissioning process results for the project. Commissioning reports include an executive summary, issues log, deferred our seasonal testing, and recommendation to accept the project.

T. Commissioning Record: A compilation of all commissioning related documents produced as part of the project. This record includes but is not limited to final Cx documents, meeting minutes, start-up documents and more. The Cx Record can be combined with the Cx Final Report or be provided as a stand-alone document.

U. Commissioning Team (CT): The qualified group that will plan and carry out the overall commissioning process. The team is composed of the CxA, OR, A/E Team, GC/CM, Subs, equipment manufacturers and other parties identified by the CxA. The individual participants on the team may change as the design and construction process proceeds. Participation by the OR is not mandatory, but the value of these services to the customer is directly proportional to their participation.

V. Construction Phase: Phase of construction that begins once construction commences and continues until TAB and Functional Performance Testing. This phase includes the commissioning submittal review, development and execution of Pre-Functional Checklists, site observations and equipment startup.

W. Datalogging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data loggers separate from the control system.

X. Deferred Testing: FPT's that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that prevent the test from being executed during the Acceptance Phase of the project.

Y. EC: Electrical Contractor

Z. Functional Performance Test (FPT): Testing and documenting of the dynamic function and operation of equipment and systems to verify and demonstration operation in accordance with the OPR, BOD and contract documents. Using manual (direct observation) and/or monitoring methods, systems and equipment are tested under various conditions, such as low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's Sequences of Operation and components are verified to be responding as the sequences state. The CxA develops the FPT procedures in a sequential written form, coordinates, oversees, and documents the actual testing, which is usually performed by the installing contractor or vendor. FPT's are performed after Pre-Functional Checklists, startup, TAB and controls checkout are complete and the COR is received. The Subs are responsible for reviewing, understanding, and performing the FPT's.

AA. GC/CM: General Contractor / Construction Manager

BB. HVAC: Heating, Ventilating and Air Conditioning

CC. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.

DD. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the “observation”).

EE. MC: Mechanical Contractor

FF. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.

GG. O&M: Operation and Maintenance

HH. Occupancy Phase: Phase of the project after the Acceptance Phase. During this phase, commissioning requirements are to correct any remaining Commissioning Issues, carry out any required re-testing, deferred or seasonal testing, close-out documentation review and warranty review.

II. OR: Owner’s Representative

JJ. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50°F to 75°F to verify economizer operation). See also “Simulated Signal”.

KK. PC: Plumbing Contractor

LL. Pre-Functional Checklist (PFC): A list of items to inspect to verify proper installation of equipment

and systems. PFCs are developed and provided by the CxA with execution being completed by the Subs, CxA or a combination thereof depending on the scope of services. PFCs are primarily static inspections and procedures to prepare the equipment or system for initial operations (e.g., belt tension, oil levels OK, labels affixed, gages in place, etc.).

MM. Request for Information (RFI): An official document submitted to the A/E to provide clarity or direction on a specific question or issue that has arisen.

NN. Sampling: Performing observation, review, testing or other verification on only a fraction of the total number of identical or near identical pieces of equipment, drawings, events, etc. Sampling techniques include random statistical sampling and less form professional judgment methods.

OO. Seasonal Testing: FPTs that are deferred until the system(s) will experience conditions closer to their design conditions.

PP. Sequence of Operations (SOO): A written description of how equipment and systems are intended to operate. SOOs include control logic, setpoints, alarm requirements, trend requirements and other information necessary to properly program and commission the system. SOOs are developed by the EOR, and final versions are provided by the CC on the approved controls submittal.

QQ. Simulated Condition: Condition that is created for the purpose of testing the response of a system.

RR. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.

SS. Start-up: The initial starting or activating of dynamic equipment, including executing Pre-Functional checklists.

TT. Subs: Subcontractors

UU. TAB: Testing, Adjusting and Balancing

VV. VV. TABC: Testing, Adjusting and Balancing Contractor

WW. WW. Test Procedures: The step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA with assistance and coordination from GC/CM and Subs.

XX. XX. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test procedures are not the detailed test procedures. The test requirements are specified in the Contract Documents.

YY. YY. Trending: Monitoring of BAS information by logging data at set intervals or when there is a change of value.

1.6 COMMISSIONING TEAM

A. Commissioning requires the participation of all project team members to be an effective and efficient process. This team is made of individuals from the Owner, Design and Construction teams as identified in this section. The commissioning team is fluid, and additional project team members may be added as needed throughout the project.

B. Commissioning Team members appointed by Owner:
   1. CxA – Commissioning Agent
   2. OR – Owner's Representative, ideally member(s) of the O&M staff
   3. A/E – Architect and Engineering design professionals

C. Commissioning Team members appointed by the Contractor(s):
   1. GC/CM – General Contractor/Construction Manager
   2. MC – Mechanical Contractor
   3. EC – Electrical Contractor
   4. PC – Plumbing Contractor
   5. CC – Controls Contractor
   6. TABC – TAB Contractor
   7. Equipment Suppliers and Vendors
   8. Envelope Contractor(s)

1.7 COMMISSIONING SUBMITTALS

A. This section identifies the commissioning submittals that the GC/CM and A/E are responsible for providing to the CxA for completion of commissioning related tasks.

B. Construction Documents, RFIs, Sketches and other design documents:
   1. The A/E shall provide the CxA all current design documents. When contract document

updates are issued, the CxA shall be included on the distribution of those documents.
2. The CxA shall receive copies of all drawing updates that are not provided as part of official document updates, such as sketches.
3. The GC/CM and A/E shall ensure the CxA receives copies of all RFIs related to commissioned systems. This includes both the original RFI submitted to the A/E as well as any response provided. The CxA may provide input on RFIs to the A/E.

C. Construction Submittals:
1. The CxA will identify submittals to the GC/CM that are required concurrent with the submission to the A/E. The CxA's review shall be limited to the equipment being commissioned with the commissioning review focused on confirming compliance with the contract documents. The CxA will provide commissioning review comments to the A/E.
2. The GC/CM shall provide final approved copies of the submittals to the CxA for development of project specific commissioning documentation.

D. Completed PFCs:
1. The GC/CM shall provide all completed PFCs to the CxA prior to scheduling and execution of Start-up with sufficient time allowed for CxA back-check as detailed elsewhere in this document.

E. Start-Up Plan:
1. The GC/CM, with assistance from the Subs and equipment vendors responsible for purchase, installation and start-up of equipment, shall develop a Start-Up Plan and executes equipment start-up utilizing the following procedure.
    a. Compile detailed start-up and checkout procedures from equipment manufacturers and industry standard field checkout sheets. Start-up documentation shall include checklists and procedures with specific boxes or lines for recording and documenting inspections of each piece of equipment.
    b. Submit the Start-Up Plan to the CxA for review in discipline specific books/sections which shall include the following at a minimum:
        i. Cover sheet for each Start-Up Plan book/section. Each Start-Up Plan shall have an individual, discipline specific tag (e.g. Mechanical Start-Up Plan (Volume 1, 2, 3, etc.), Electrical Start-Up Plan, Plumbing Start-Up Plan, etc.).
        ii. Table of Contents for each book/section.
        iii. Schedule of start-up activities by equipment (initial Start-Up Plan submittal schedule shall be tentative; start-up schedule shall be updated as construction proceeds and forwarded to CxA so that CxA can witness start-up activities as required).
        iv. Separate tagged divider by specification section with all related systems testing documentation (duct pressure testing, duct cleaning, piping flushing and pressure testing, electrical acceptance testing, etc.).
        v. Separate tagged divider by specification section with start-up checklists and documentation for each item of equipment.
2. The CxA, A/E and OR reviews the Start-Up Plan for content and format. The CxA shall return the Start-Up Plan with comments to GC/CM and the GC/CM shall revise the Start-Up Plan based on CxA comments.
3. The GC/CM shall forward copies of completed Start-Up Plan sections as the work is completed, including all executed start-up checklists, to CxA for review to verify completion of start-up activities. An executed Start-Up Plan must be submitted to CxA prior to scheduling of FPTs.
4. Once all start-up activities are complete, the GC/CM shall submit a complete, compiled Start-Up plan for documentation. Any comments made by the CxA on individual section submissions shall be incorporated.

F. CORs:
1. The GC/CM shall submit completed CORs to the CxA for each piece of equipment or system prior to scheduling and execution of FPTs.
2. At a minimum, COR must confirm and certify that the following:
    a. PFCs are complete and submitted to the CxA.

b. All previously identified Cx Issues for the related equipment/system have been resolved and verified.
c. Start-up and checkout activities have been completed successfully and all documents have been submitted to the CxA.
d. TAB is complete and all documentation has been submitted to the CxA.
e. Controls programming is complete and operational, including graphical user interface, trending, alarming, scheduling and other systems necessary for a complete BAS.
f. Subs and/or manufacturers' representatives will be made available as necessary for the execution of FPTs.

3. Each COR shall include the following for both the GC and associated Subs:
   a. Printed Name
   b. Title
   c. Company
   d. Signature
   e. Date
4. Sample COR templates can be provided by the CxA.

G. Training Plan:
1. The GC/CM shall develop and complete the Training Plan as outlined in section 01 79 00.

H. Turnover Documents:
1. The GC/CM shall provide the following turnover documents to the CxA for review:
   a. As-Built Drawings, including final controls SOOs and Setpoints.
   b. O&M Manuals
   c. Owner Training Documents

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. All testing equipment required to perform startup and initial checkout and required FPTs shall be provided by the GC/CM, Subs or equipment vendors for the equipment being tested.

B. Special equipment, tools, and instruments (only available from vendor, specific to a piece of equipment) required for testing or maintaining equipment shall be included in the base bid price to the GC/CM and shall be left on site for use by the Owner's O&M staff.

C. Test equipment shall be of sufficient quality and accuracy to test and/or measure system performance with tolerances specified. A testing laboratory shall have calibrated test equipment within the previous 12 months. Calibration shall be NIST traceable. Equipment shall be calibrated according to manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

D. Reference discipline specific specification sections for additional test equipment requirements.

PART 3 EXECUTION

3.1 COMMISSIONING PROCESS OVERVIEW

A. The following provides a brief overview of the commissioning tasks during the construction, acceptance, and occupancy phases and are listed in the approximate order in which they occur:
1. Submittals for commissioned systems and equipment are provided to the CxA by the GC/CM concurrent to the A/E as part of the normal submittal process.
2. Final approved submittals are forwarded to the CxA by the GC/CM or Subs for use by the CxA during the commissioning process.
3. The CxA develops equipment specific PFCs.
4. Prior to executing onsite work, the CxA will organize and lead a Commissioning Kick-Off meeting. This meeting involves the entire CT and provides a thorough review of the upcoming commissioning tasks, discusses roles and responsibilities and answers any commissioning related questions.
5. The CxA ensures all PFCs are completed prior to equipment start-up and execution of FPTs.
6. The CxA develops project specific FPT plans. These plans are created by using both the contract documents and approved submittals. FPT plans are provided to the GC/CM, Subs, A/E and OR for review and comment.

7. The GC/CM coordinates and executes equipment startup and checkout activities.
8. TAB is executed and documentation is submitted according to the contract documents.
9. The GC/CM submits CORs to the CxA to indicate systems and equipment are ready to begin executing FPTs.
10. The CxA coordinates the execution of the FPTs with the assistance of the Subs.
11. Owner Training is completed by the GC/CM in accordance with the contract documents.
12. The CxA issues the Cx Final Report and Cx Record. These documents may be a single file.

3.2 ROLES AND RESPONSIBILITIES

A. The general responsibilities of various commissioning team members are provided in this subsection. Specific responsibilities will be provided in the Cx Plan.

B. OR's Responsibilities:
1. Facilitate, support and participate in the commissioning process.
2. Provide final approval of the commissioning work.

C. Architect/Engineer Responsibilities:
1. Develop and provide the OR Approved BOD document to the CxA.
2. Attend selected commissioning meetings as needed or requested by the CxA.
3. Provide copies of all design documents including all drawings, specifications and revisions to those documents, sketches, RFIs or other documents that Review and respond to any Design Review Comments. Incorporate any necessary changes in future drawing releases.
4. Review CxA Submittal Review comments. Any comments deemed valuable shall be incorporated into official submittal responses by the A/E. Any comments that are not included shall be provided with written responses from the A/E detailing why for record purposes.
5. Participate in the resolution of Commissioning Issues identified during the project as needed or requested by the CxA.
6. Review and comment on FPT plans developed by the CxA to ensure compliance with the design intent of the system and equipment.
7. Review and approval all final Cx Documents produced the CT members.

D. General Contractor/Construction Manager Responsibilities:
1. Incorporate commissioning activities and milestones into the overall project schedule. Provide updates as necessary.
2. Ensure all Subs and equipment vendors fully participate in the commissioning process and execute their responsibilities.
3. Attend, along with all necessary Subs, commissioning progress and coordination meetings.
4. Provide the CxA copies of all OAC meeting minutes, RFIs and other construction progress or change related documents.
5. Notify the CxA when equipment is ready for observation, PFC and FPT completion.
6. Coordinate with the CxA regarding planning, scheduling and execution of all startup and testing activities. Submit all plans, reports and completed forms to the CxA and A/E for review and approval.
7. Coordinate with appropriate Subs and vendors to ensure timely resolutions to commissioning issues.
8. Review and comment on the FPT plans developed by the CxA.
9. Ensure Subs provide technicians, equipment or other tools requested by the CxA in order to complete commissioning activities including but not limited to the execution of FPTs.
10. Submit CORs to the CxA prior to scheduling FPTs.
11. Compile and submit all closeout and turnover documents to the A/E and CxA for review and approval including but not limited to As-Built drawings and O&M Manuals.
12. Coordinate and execute Owner Training in accordance with the contract documents, specifically *Division 01 80 00* Minimum Owner Training Requirements.
13. Participate in the 10-Month warranty review and ensure resolution of all identified issues prior to the completion of the warranty period.

E. Commissioning Agent's Responsibilities:
   1. Organize and lead the Commissioning Team in the execution of all commissioning activities.
   2. Develop the Commissioning Plan and Commissioning Specifications that clearly define the commissioning process and team member roles and responsibilities and provide sample documentation.
   3. Review the contract documents for constructability, commissionability and maintainability.
   4. Review submittal documents for conformance with the contract documents for commissioned systems and equipment.
   5. Develop equipment specific Pre-Functional Checklists and project specific Functional Performance Test scripts.
   6. Plan and lead commissioning related meetings as necessary to coordinate commissioning tasks and discuss commissioning issues.
   7. Conduct periodic site visits to collect commissioning documents and completed a back check of contractor completed PFCs, review progress of installation and document Commissioning Issues.
   8. Develop and maintain the Cx Issues Log to track all identified Cx Issues, resolutions and commentary from the GC/CM, Subs, OR and A/E.
   9. Provide regular reports on progress of the commissioning activities, including any currently unresolved Commissioning Issues.
   10. Participate in the GC/CM's startup process by reviewing startup plans, witnessing selected startup activities and reviewing completed startup documentation.
   11. Verify that TAB work is completed properly by reviewing the TAB report and performing limited verification with the assistance of the TABC.
   12. Review turnover documents for completeness and accuracy including but not limited to As-Built drawings, O&M Manuals and the Systems Manual.
   13. Verify Owner Training has been completed according to the Minimum Owner Training Requirements.
   14. Develop and issue the Cx Final Report. The Cx Record may be included as part of the Cx Final Report or be issued as a separate document.
   15. Recommend acceptance of the commissioned equipment and systems to the OR.
   16. Direct and witness any seasonal or deferred FPTs that could not be completed during the acceptance phase FPT period.
   17. Plan and conduct a project close-out and lessons learned meeting with the OR, GC/CM and A/E.

3.3 SCHEDULING AND COORDINATION

A. Kick-off Meeting: Prior to beginning onsite work the CxA will plan, schedule and conduct a commissioning kick-off meeting. Roles and responsibilities of the Commissioning Team will be clarified at this meeting along with a review of the Cx Plan. The CxA will distribute meeting minutes to all parties.

B. The CxA will work with GC/CM to establish protocols to schedule the commissioning activities. The CxA will review the Construction Schedule and verify that PFCs and FPTs are properly scheduled. The GC/CM will integrate all commissioning activities into the master schedule.

C. The GC/CM shall notify the CxA of any changes in the construction schedules that will affect commissioning activities. The CxA will work with the GC/CM and Sub(s) to schedule new dates as necessary. The GC/CM shall notify the CxA a minimum of five (5) days in advance of scheduled commissioning visits if re-scheduling is required.
   1. Any time for the CxA to visit the site to execute commissioning tasks on equipment or systems that were identified as being ready by the GC/CM but found to not be, will be back charged to the GC/CM at a cost of $2,500 plus expenses per man-day.

D. The GC/CM and Sub(s) shall schedule their representatives as required by the CxA to complete all commissioning activities.

3.4 PRE-FUNCTIONAL CHECKLISTS

A. Objectives and Scope:
   1. The objective of PFCs is to verify and document that the equipment/systems are provided and installed according to the contract documents, manufacturers' recommendations and industry standards. Each piece of commissioned equipment shall receive a PFC that must be completed and approved prior to start-up.

B. Development of Documents:
   1. The CxA is responsible for developing equipment specific PFCs for each piece of commissioned equipment. No equipment shall share completed PFC documents.
   2. Sample PFCs are provided in the Cx Plan and can be obtained from the CxA. The samples are provided to give the Subs a general idea of the content and scope of the PFC process. The sample PFCs are prototypical, and do not reflect specific requirements of this project's plans or specifications.

C. Execution:
   1. Subs are responsible for executing all PFCs and shall provide the CxA with signed and dated copies of completed PFCs prior to verification by the CxA. Only individuals who have direct knowledge that a line-item task was actually performed will complete that line item. Subs shall clearly list PFC items not completed successfully. Completed forms documenting any outstanding deficiencies shall be provided to CxA within two (2) working days of completion.
   2. The CxA will verify the PFCs completed by the Subs. Verification includes review of completed checklist items and random backchecking of submitted data to confirm accuracy. Any issues identified will be added to the Cx Issues Log and may delay start-up or FPTs.
   3. Any PFC item or associated Cx Issue marked as complete which is later found to be incomplete and causes re-verification work by CxA or delays during FPTs will be backcharged to the party responsible.
   4. All PFCs will be completed using the Commissioning Software Platform BlueRithm.

3.5 START-UP AND INITIAL CHECKOUT

A. The GC/CM shall develop the Start-Up Plan and submit to the CxA, A/E, and OR for approval a minimum of thirty (30) days prior to the anticipated start of start-up activities.

B. After receiving approval of the Start-Up Plan, the GC/CM shall organize and lead a Start-Up Coordination Meeting. All CT members shall attend and provide feedback on start-up activities.

C. Subs and/or equipment vendors shall execute equipment start-ups per the Start-Up Plan.

D. The GC/CM shall provide the CxA with signed and dated copy of completed Start-Up Plan documents prior to scheduling of FPTs. Only individuals having direct knowledge that a line-item task was actually performed shall complete the documentation.

E. Subs shall clearly list outstanding items or initial start-up tests that are not completed successfully. Completed forms documenting any outstanding deficiencies shall be provided to CxA within two (2) working days of completion.

3.6 FUNCTIONAL PERFORMANCE TESTS

A. Objective and Scope:
   1. The purpose of FPTs is to document and verify that all equipment and systems are operating according to the design intent and as defined in the contract documents and approved submittals. The process of FPTs facility bringing a system from a state of substantial completion to fully dynamic operation.
   2. Each component and system are operated through all modes of operation (occupied, unoccupied, etc.) where specific equipment and system responses are required. All control SOOs are tested and verified, including all safeties and alarms.
   3. FPTs are only performed on dynamic pieces of equipment. Static system components (i.e. panelboards, louvers, etc.) do not undergo FPTs.

B. Development of Documents:
   1. The CxA will develop project specific test procedures and forms to verify and document equipment and system operation. These test procedures are developed from a combination of the contract documents and approved submittals.
      a. The GC/CM shall provide all documents requested by the CxA for the development

of FPT test procedures.

b. The GC/CM shall authorize the Subs and equipment vendors to assist the CxA in development of the test procedures as requested by the CxA.

2. Once developed, the CxA will issue the FPT test procedures to the CT for review and comment. It is imperative that all members thoroughly review these procedures for feasibility, safety, and warranty protection as well as conformance to the design intent. If necessary, the CxA will coordinate a meeting to discuss any concerns. Based on CT feedback, the CxA will make any necessary updates to the FPT test procedures.
   a. Failure to properly review FPT test procedures and identify any feasibility or other issues by the GC/CM, Subs or equipment vendors during the review period that are identified during test execution will be handled as non-conformance Cx Issues.

C. Execution:
1. Prior to scheduling FPT execution, complete CORs must be received by the CxA and all associated documentation. All start-up, checkout, TAB and other testing must be complete and final prior to FPTs.
2. The GC/CM shall provide the CxA a minimum of fourteen (14) days' notice for when FPTs may begin.
3. The CxA will conduct an FPT coordination meeting with the CT. This meeting will serve to schedule the execution of FPTs, answer any questions and remind each CT member of their roles and responsibilities.
4. The GC/CM shall ensure that the Subs and/or equipment vendors provide trained technicians familiar with the project to assist in the execution of FPTs.
5. The Subs and/or equipment vendor technicians will execute the FPT test procedures. The CxA will direct and document the results of the FPT.
6. FPTs will be completed under design conditions whenever possible. Simulated conditions or signals may be used when not practical under design conditions as the discretion and direction of the CxA. The CxA will determine how to best simulate the conditions needed for the test.
7. If any line of an FPT test procedure is unsuccessful or fails, that line item and/or test section will be deemed to be in non-conformance and identified as a Commissioning Issue.
8. When an FPT is completed and any identified Commissioning Issues are resolved, the CxA, GC/CM, Subs and/or equipment vendor shall sign off that testing is complete and successful, and the equipment is ready to be turned over to the Owner.

D. Deferred Testing:
1. If any FPT cannot be completed due an unforeseen condition outside the control of the GC/CM or CxA, execution shall be deferred based on the recommendation of the CxA and approval of the OR. The affected testing shall be completed as soon as practical.
2. Costs associated with deferred testing are the responsibility of the GC/CM, Subs and equipment vendors. Deferred tests are tests that have not been performed, therefore any costs associated with those tests have not been utilized.

E. Seasonal Testing:
1. Seasonal testing are FPTs that are executed during the opposite season of the initial FPTs. The intent of seasonal testing is to verify equipment operation during both weather extremes.
2. Seasonal testing shall be executed during ASHRAE design condition months. If possible, scheduling should be flexible to coordinate testing on days as close to design condition as possible.
3. The GC/CM shall ensure participation by the Subs and/or equipment vendors. The same technician made available during the initial FPTs shall be made available for seasonal testing.

3.7 NON-CONFORMANCE AND COMMISSIONING ISSUES

A. The CxA will document any observations, installation issues or operational non-conformance issues as Commissioning Issues and be tracked in the Commissioning Issues Log.

B. All Commissioning Issues identified prior to the execution of FPTs must be resolved by the GC/CM and Subs and verified by the CxA prior to scheduling FPTs.

C. Non-conformance Commissioning Issues identified during the execution of FPTs must be completed prior to release of the GC/CM and Subs retainage.

D. Commissioning Issues will be handled in the following manner:

1. When there is no dispute on the Cx Issue and Subs accept responsibility for remedial action:
   a. The CxA documents the Cx Issue in the Cx Issues Log and distributes to the CT.
   b. The GC/CM facilitates the resolution of the issue and assigns Cx Issues to the appropriate Subs and equipment vendors.
   c. Subs and equipment vendors make necessary modifications and submit written response to GC/CM stating necessary changes have been made. GC/CM reviews the work and forwards the response to the CxA if they agree that the Cx Issue is resolved.
   d. The CxA verifies the resolution is satisfactory and indicates the Cx Issue as corrected.
2. When there is a dispute about the Cx Issue regarding whether the issue is valid or who is responsible:
   a. The CxA documents the Cx Issue in the Cx Issues Log and distributes to the CT.
   b. The GC/CM facilitates the resolution of the issue. If assistance is needed, additional parties may be brough into the discussions, including the CxA. Final interpretive authority is with the A/E. Final acceptance authority is with the OR.
   c. The CxA documents the final interpretation and resolution process.
   d. If Subs and equipment vendors are to make necessary modifications and submit written response to GC/CM stating necessary changes have been made. GC/CM reviews the work and forwards the response to the CxA if they agree that the Cx Issue is resolved.
   e. The CxA verifies the resolution is satisfactory and indicates the Cx Issue as Corrected.
   f. If the A/E or OR are going to accept the Cx Issue as is, the Cx Issues Log shall be updated to indicate the issue as Accepted.

E. Costs associated with verification or re-testing of Cx Issues:

1. Costs Subs or equipment vendors to re-verify Cx Issues identified during the project, if they are responsible for the issue, will be theirs.
2. If Subs are not responsible for a Cx Issue but are required for verification or re-testing, cost recovery may be negotiated with the GC/CM.
3. Time for the CxA to conduct verification of Cx Issue resolutions or re-testing due to Cx Issues being reported as resolved but found to not will be back charged to the responsible Subs at a cost of $2,500 plus expenses per man-day.

3.8 OWNER TRAINING

A. The GC/CM is responsible for execution of Owner Training as outlined in *Division 01 80 00*.

DIVISION 02 26 23 – LEAD / ASBESTOS / HAZARDOUS MATERIAL NOTICE

GENERAL

Lead/Asbestos containing building materials (ACBM) shall not be used in the construction of the project. The designer shall submit a signed statement that to the best of the designer's knowledge that, "no lead/asbestos containing building material (ACBM) was specified as a building material in any construction document for the project or was used in the building". This statement shall be included in all project documents that include but are limited to the construction drawings and project manual.

Notice: In no event is a product to be used in this project known to contain any hazardous or toxic waste or material, radioactive materials, or other contaminants, the removal of which is required or the maintenance of which is prohibited, regulated or penalized by any local, state, or federal agency, authority or governmental unit. If any product is inadvertently specified which contains such materials, it is the Contractor's, subcontractor's and supplier's obligation and duty to advise the Architect/Engineer of this fact prior to the ordering and/or installing of the product or material.

Hazardous Substances: Discovery of a suspected dangerous or hazardous substance during construction stops construction operations and may seriously delay a project. Contractors often encounter asbestos, lead, polychlorinated biphyenyls (PCBs), and similar hazardous materials on their construction projects. Because the use of those materials was common until recently, they are often found on renovation projects involving older buildings. AIA Document A201 outlines procedures contractors must follow when suspected dangerous or hazardous substances are uncovered during construction. If the suspect material proves to be a dangerous or hazardous substance, a contractor is not permitted to resume construction operations until the material has been rendered harmless or has been lawfully removed from the site.

On file in the office of each existing school (and with a copy in the Department of Facilities Management office) there should be an asbestos management plan, field of study, etc. that details the types and locations of lead/asbestos containing materials (ACBM) within the building(s). This management plan is available for the Architect's and contractor's review upon request. If under any circumstance these documents are not readily available and current, the contractor must comply with all requirements that will ensure all state and local codes are met. Under all circumstances, asbestos management plan, field of study, etc. must be included in close-out documents. If any materials suspected to contain lead/asbestos are encountered in an addition or renovation work, the Owner's "AHERA DESIGNEE" shall be contacted immediately to investigate and testing of these materials. The Owner shall have the option to either remove the material or supervise the removal of any asbestos containing material by an independent contractor hired and paid by the Owner. A statement to this effect shall be included in the Project Manual.

DIVISION 02 30 00 – SUBSURFACE CONDITIONS

PART 1 GENERAL

1.01 REPORT

A. A Soil Investigation Report has to be prepared for use prior to designing new projects.

1.02 ADDITIONAL INVESTIGATION

A. Contractor should visit site and acquaint themselves with site conditions.

B. Prior to bidding, contractor may make his own subsurface investigation, but Contractor shall make no deviations from the Contract Documents without specific and written approval.

DIVISION 02 40 00 - DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Building demolition excluding removal of hazardous materials and toxic substances.

B. Selective demolition of built site elements.

1.02 RELATED REQUIREMENTS

A. *Division 01 50 00* - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

B. *Division 01 70 00* - Execution and Closeout Requirements: Project conditions; protection of benchmarks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

C. *Division 31 20 00* - Earth Moving: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.

B. Site Plan: Indicate:

1. Areas for temporary construction and field offices.
2. Areas for temporary and permanent placement of removed materials.

C. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.

1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.

2. Summary of safety procedures.

D. Demolition firm qualifications.

E. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill Material: See *Division 31 20 00*.

PART 3 EXECUTION

3.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3. Provide, erect, and maintain temporary barriers and security devices.
   4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   5. Do not close or obstruct roadways or sidewalks without permits from authorities having jurisdiction.
   6. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
   7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Protect existing structures and other elements to remain in place and not removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

EQUIPMENT REMOVAL: The Designer and Project Manager shall schedule time for the Owner to remove material and equipment to be saved or salvaged. Designer is to provide a statement to include in the scope of work that the Contractor is to remove, store, and protect existing equipment for possession by Owner if Owner is not able to remove equipment and material prior to the Contractor's start date. If lead/asbestos abatement of a building is required and not included in the project's base bid, the Department of Facilities Management will specify the work and bid the project in a separate contract prior to start of construction. A statement about this effect shall be included in the Project Manual. **Contractors are responsible for their own utilities locates, including private.**

3.02 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

3.03 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.
B. Leave site in clean condition, ready for subsequent work.
C. Clean up spillage and wind-blown debris from public and private lands.

UTILITY DISCONNECTION: Coordinate with MLGW, Shelby County Water Services, early in the project to discontinue or interrupt services to the building. This will allow the utility time to respond prior to demolition and after the abatement of any lead/asbestos is completed. Timing is critical, so as not to delay the project. Where utility relocation is required for an addition to an existing building, the utility shall be provided with all needed information as soon as documents are complete, along with an estimated schedule for when the work will be required. If utilities will be disrupted in an occupied school, the principal and MSCS shall be notified 48 hours before the disruption. A statement about this effect shall be included in the Project Manual.
Contractors are responsible for their own utilities locates, including private.

EXISTING ELEVATORS: Designer to contact the MSCS elevator maintenance vendor during the design process to discuss renovation plans and review the Code required modifications to the existing elevators. Elevator maintenance vendor will submit a proposal to perform required upgrades, and work shall be contracted directly by MSCS.

SLABS ON GRADE: The Designer shall include detailed information in the Construction Documents to cover the scope of work required to maintain or repair in place radon mitigation systems under slabs on grade that are to be cut during renovation, including radon barriers.

Demolition of Building Structures

- This scope outlines the work required to safely and efficiently demolish existing metal buildings located at [Insert Project Site]. The demolition will include structural disassembly, material removal, site cleanup, and disposal in accordance with Health Department and AHJ's regulations. This scope of work outlines the requirements and procedures for the demolition and removal of existing metal buildings located at [Project Site Address]. The work includes disassembly, removal, disposal, and site cleanup.
- Demolish and remove existing metal building structure, including steel framing, roofing, siding, concrete slab, and associated utilities.
- (SEE ALTERNATE #1 BELOW) Perform all work in accordance with LEED BD+C v4 or v4.1 requirements to support certification goals (e.g., Silver, Gold, Platinum).

1. Pre-Demolition Activities

- Site Assessment: Inspect buildings for hazardous materials (e.g., asbestos, lead paint). This standard applies to all construction activities involving asbestos, lead, or any type of common hazardous waste during demolition, renovation, and maintenance.
- Permitting: Obtain necessary demolition permits and approvals for AHJ.
- Utility Disconnection: Coordinate with utility providers to disconnect water, gas, electricity, and communications.
- Safety Planning: Develop and implement a site-specific safety plan, including fencing, signage, and PPE requirements.
- Pest Control: Conduct a Pest Assessment by Engaging Licensed Pest Control Operators (PCOs)
- Coordinate with Local Authorities: Work with environmental health departments and housing authorities to address pest issues on adjacent properties.

2. Demolition Scope

- Structural Disassembly:
    - Remove roofing panels, wall panels, and insulation.
    - Dismantle steel framing, including columns, beams, and trusses.
    - Remove doors, windows, and other fixtures.
- Foundation Removal (if applicable):
    - Break up and remove concrete slabs and footings.
    - Excavate and backfill as needed.
- Implement Integrated Pest Management (IPM):
    - Use a combination of exclusion, restriction, and destruction methods.

- Monitor pest activity continuously and adjust strategies as needed.

3. Material Handling

- Salvage and Recycling:
  - Identify and segregate salvageable materials (e.g., steel, aluminum).
  - Transport recyclable materials to approved facilities.
- Waste Disposal:
  - Dispose of non-recyclable debris in accordance with local environmental regulations.
  - Maintain documentation of disposal and recycling activities.

4. Site Restoration

- Cleanup:
  - Remove all debris and hazardous materials.
  - Grade and level the site as required.
  - Seed and Straw all disturbed areas
- Final Inspection:
  - Conduct final walkthrough with project stakeholders.
  - Ensure compliance with all demolition and environmental standards.

5. Deliverables

- Demolition schedule and progress reports.
- Waste and recycling documentation.
- Final site condition report

LEED-Specific Requirements (Alternate #1)

A. Waste Management Plan

- Develop and implement a Construction and Demolition Waste Management Plan (CWMP).
- Target diversion rate: Minimum 75% of total waste by weight from landfills.
- Identify at least five material streams for diversion (e.g., steel, concrete, wood, cardboard, soil).
- Track and report waste quantities monthly, including:
  - Hauler name
  - Destination facility
  - Weight of salvaged, recycled, and landfilled materials

B. Material Reuse and Recycling

- Salvage reusable materials such as:
  - Structural steel
  - Metal panels
  - Concrete (for aggregate or backfill)
  - Wood (for blocking or reuse)
- Separate recyclable materials on-site using clearly labeled containers.
- Avoid contamination of recyclable streams.

C. Energy Efficiency in Demolition

- Use equipment and methods that minimize fuel consumption.
- Optimize transportation routes for hauling debris.
- Consider deconstruction over mechanical demolition where feasible.

F.Site Preparation

- Secure perimeter fencing and signage.
- Designate and label waste sorting areas.
- Protect adjacent structures and vegetation.
- Disconnect and cap utilities (electric, water, gas, sewer).

E. Demolition Activities

- Remove non-structural elements first (doors, windows, interior finishes).
- Dismantle structural steel and metal panels systematically.
- Break and remove concrete slab and foundations.
- Sort and stockpile materials for reuse, recycling, or disposal.

F. Environmental Controls

- Implement dust suppression measures (e.g., water spray).
- Prevent stormwater runoff contamination.

- Monitor noise levels and comply with local ordinances.

G. Documentation and Reporting

- Maintain daily logs of demolition progress.
- Submit monthly waste diversion reports.
- Provide final summary report for LEED documentation.

DIVISION 03 00 00 - CONCRETE

GENERAL

SIDEWALKS: Specify structural 3500 PSI concrete. Preferred reinforcement is concrete fiber reinforcement and admixtures. Alternative reinforcement is minimum 6x6/ W2.9 x W2.9 welded wire fabric.

SLABS ON GRADE: The Designer shall include detailed information in the Construction Documents to cover the scope of work required to maintain or repair in place radon mitigation systems under slabs on grade that are to be cut during renovation, including radon barriers.
STAINED/ COLORED CONCRETE: The use of stained or colored concrete for exterior applications such as courtyards and sidewalks is not permitted. Use of stained/ colored concrete shall be considered for interior use only and on a case-by-case basis.

STAIRS AND RAMPS: Concrete stairs and ramps provided at platforms and stages shall be provided with the ability to be accessed by the audience. Mechanical lifts to platforms and stages will only be considered on a case-by-case basis when ramp access is not attainable. Aluminum/ metal ramps and stairs will be considered on a case-by-case basis in relation to schedule and project budget.

EXPANSION AND CONTROL JOINTS: Expansion and control joints shall be shown in structural drawings. MSCS requests that joints not exceed 120 square feet or 10x12 feet on center. Designers shall coordinate control joints with all finishes, i.e. terrazzo, VCT, to minimize compromises to finish material i.e. breaks, cracks, etc.

EXTERIOR SLABS, INTERIOR SLABS, AND SIDEWALKS

1.GENERAL

1.1 Scope

Provide all labor, materials, equipment, and supervision necessary to complete:

- Cast-in-place exterior concrete slabs
- Cast-in-place interior concrete slabs-on-grade
- Concrete sidewalks

Including subgrade preparation, reinforcement, jointing, finishing, curing, and protection.

1.2 Reference Standards Comply with latest editions of:

- ACI 301 – Specifications for Structural Concrete
- ACI 302.1R – Guide for Concrete Floor and Slab Construction
- ACI 330R – Guide for Concrete Parking Lots
- ASTM C94 – Ready-Mixed Concrete
- ASTM A615 – Deformed Steel Bars
- ASTM A1064 – Welded Wire Reinforcement

2. PRODUCTS

2.1 Concrete Mix Design

Exterior Slabs & Sidewalks

- Compressive Strength: 4,000 psi at 28 days
- Air Entrainment: 5–7%
- Maximum Slump: 5 inches
- Maximum Water-Cement Ratio: 0.45
- Aggregate: ¾” normal weight

Interior Slabs

- Compressive Strength: 3,500–4,000 psi at 28 days
- Air Entrainment: Not required (unless exposed to freeze/thaw)

- Maximum Slump: 5 inches
- Maximum Water-Cement Ratio: 0.50

2.2 Reinforcement

- Welded Wire Mesh: 6x6 W2.9/W2.9 minimum

OR

- #4 Rebar at 18” O.C. each way (as shown on drawings)

Support reinforcement on chairs to maintain proper position.

2.3 Vapor Barrier (Interior Slabs Only)

- 10-mil minimum polyethylene vapor retarder
- Installed directly beneath slab
- Overlap seams 6 inches and tape

2.4 Base Material

- 4” minimum compacted crushed stone (¾” minus)
- Compacted to 95% Standard Proctor

3. EXECUTION

3.1 Subgrade Preparation

- Remove vegetation, organic material, soft spots.
- Proof-roll subgrade.
- Compact to 95% Standard Proctor.
- Maintain uniform moisture content.
- Provide positive drainage away from structures.

3.2 Thickness

Exterior Slabs

- Minimum 4 inches
- 5–6 inches where subject to vehicles

Interior Slabs

- Minimum 4 inches
- 5–6 inches for garage slabs

Sidewalks

- Minimum 4 inches
- 5 inches at drive crossings

3.3 Jointing

Control Joints

- Spacing: 10’–12’ maximum
- Depth: ¼ slab thickness
- Saw cut within 6–12 hours after placement

Expansion Joints

- Install at:
    - Building interfaces
    - Columns
    - Every 20–30 feet (sidewalks)
- Use ½” pre-molded joint filler

3.4 Finishing

Exterior Slabs

- Screed and bull float
- Steel trowel NOT permitted on air-entrained exterior slabs
- Broom finish perpendicular to traffic
- Edge with ½” radius tool

Interior Slabs

- Screed and bull float
- Steel trowel finish (hard trowel if specified)
- Flatness tolerance: FF 35 / FL 25 minimum (if required)

Sidewalks

- Light broom finish

- Edge and tool joints

3.5 Slopes

- Exterior slabs: Minimum 1/8” per foot away from building
- Sidewalks: 1–2% cross slope for drainage
- Maintain ADA compliance where applicable (max 2% cross slope)

3.6 Curing

- Begin immediately after finishing
- Use:
  - Water curing
  - OR curing compound ASTM C309 compliant
- Protect from:
  - Freezing (first 7 days)
  - Rapid drying
  - Foot traffic for 24 hours
  - Vehicle traffic for 7 days minimum

3.7 Protection

- Do not use deicing salts first winter
- Protect edges from impact
- Repair cracks or damage prior to acceptance

4. ACCEPTANCE CRITERIA

- No standing water after rain
- No uncontrolled cracking exceeding 1/8”
- Surface free of scaling, spalling, or delamination
- Joints clean and properly tooled

DIVISION 03 05 00 – UNDERSLAB VAPOR BARRIER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sheet vapor barrier under concrete slabs on grade.

1.02 RELATED REQUIREMENTS

A. *Division 03 10 00* - Concrete Forming and Accessories: Forms and accessories for formwork.
B. *Division 03 20 00* - Concrete Reinforcing.
C. *Division 03 30 00* - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.03 REFERENCE STANDARDS

A. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.
B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturers' data on manufactured products.
C. Test Data: Submit report of tests showing compliance with specified requirements.
D. Samples: Submit samples of underslab vapor barrier to be used.
E. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS

2.01 MATERIALS

A. Underslab Vapor Barrier:
   1. Water Vapor Permeance: Not more than 0.010 perms (0.6ng/(s m2 Pa)), maximum.
   2. Complying with ASTM E1745 Class A.
   3. Thickness: 15 mils (0.4 mm).
   4. Basis of Design:
      a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil): www.stegoindustries.com/#sle.

b. W.R. Meadows, Inc.: Perminator (15-mil): www.wrmeadows.com.
c. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.02 INSTALLATION

A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.
C. Lap joints minimum 6 inches.
D. Seal joints, seams and penetrations-watertight with manufacturer's recommended products and follow manufacturer's written instructions.
E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
F. Repair damaged vapor retarder before covering with other materials.

DIVISION 03 10 00 – CONCRETE FORMING & ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
B. Openings for other work.
C. Form accessories.
D. Form stripping.

1.02 RELATED REQUIREMENTS

A. *Division 03 20 00* - Concrete Reinforcing.
B. *Division 03 30 00* - Cast-in-Place Concrete.
C. *Division 04 20 00* - Unit Masonry: Reinforcement for masonry.
D. *Division 04 26 13* - Masonry Veneer: Spacing for veneer anchor reglets recessed in concrete.
E. *Division 04 29 00* - Engineered Unit Masonry: Reinforcement for engineered masonry.
F. *Division 05 50 00* - Metal Fabrications: Placement of embedded steel angles, plates, pipe rail sleeves, and anchor bolts in cast-in-place concrete.
G. *Division 05 12 00* - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.
H. *Division 05 21 00* - Steel Joist Framing: Placement of embedded steel anchors, plates and joist seats in cast-in-place concrete.
I. *Division 05 31 00* - Steel Decking: Placement of steel anchors in composite decking.
J. *Division 31 23 16* - Excavation: Shoring and underpinning for excavation.

1.03 REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials 2010.
B. ACI 301 - Specifications for Structural Concrete 2010
C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary
D. ACI 347R - Guide to Formwork for Concrete
E. PS 1 - Structural Plywood 2009.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on void form materials and installation requirements.
C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each installation standard on site throughout the duration of concrete work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.
B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.

C. Protect plastic foam products from damage and exposure to sunlight.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
B. Design and construction to provide resultant concrete that conforms to design with respect to shapes, lines, dimensions and grades. Forms shall be securely tied braced in position, and shored to support safely all construction loads, sufficiently tight to prevent appreciable leakage of mortar and be clean of all debris at time of concreting. Responsibility for adequacy and safety shall be the Contractor's responsibility, but design shall be subject to approval.
C. Chamfer outside corners of beams, joists, columns, and walls with framed 3/4-inch chamfer, unless noted otherwise on the drawings.
D. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.
E. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.
F. Use the following form types:
    1. Basement Walls: Site fabricated plywood.
    2. Elevated Floor Slabs: Prefabricated glass fiber pan forms, treated for exposed to view finish.
    3. Elevated Floor/Roof Slabs: Permanent prefabricated foam panel formwork; formwork to remain.

2.02 WOOD FORM MATERIALS

A. Softwood Plywood: PS 1, C Grade, Group 2.
B. All exposed corners or edges of columns, piers, walls, etc. shall be framed with a ¾-inch chamfer, unless shown or noted otherwise on the plans.
C. Plywood: Douglas Fir species; solid one side grade; sound undamaged sheets with clean, true edges.
D. Smooth surface forms shall be used for all exposed surfaces and shall consist of the following:
    1. Concrete Exterior Form Plywood, resin overlay face on fir plywood backup 5 veneer plies, 5/8" thick by 4' x 8' sheet size, factory oiled and edges sealed.
    2. Use plywood boards, except as noted, for all exterior exposed concrete. Minimize all joints between sheets and prevent any bulging or pillowing of large sheets by back-up lumber at open spaces with a maximum distance between supports of 8".
    3. Forms for exposed concrete must be treated as finished woodwork or cabinet work. Surface material shall be laid out in as large as practicable and shall be laid out in regular and symmetrical pattern as approved. Edges of units shall be tight-butted together with clean, straight joints; any appreciable space at joints shall be filled. Maximum variation in alignment of surfaces at a joint shall be 1/16". There shall be no bulges or defects higher or lower respectively than 3/16" in four feet.
    4. Unfinished surface forms may be used for all unexposed surfaces, such as surfaces to be in contact with earth, in unfinished spaces, areas to receive finishes, and such other locations as indicated on the drawings. For these surfaces, wood No. 2 Common or Better lumber, metal or other type of forms shall be used for all surfaces that are to be plastered.
    5. Temporary openings shall be provided at the base of wall forms and at other necessary points to facilitate cleaning and inspection before concreting.
    6. The contact face of forms shall be coated with nonstaining mineral oil or other approved coating or in the case of wood forms may be thoroughly wetted (except in freezing weather). Oil coatings shall be applied and excess wiped off before placing reinforcement. Release agent shall be of a type that will not affect the rubbing, sealing or painting of the exposed concrete surface.
    7. Side forms for footings may be omitted with the approval of the Architect/Engineer where soil conditions are suitable.
    8. Forms and form lumber may be reused if in good condition after being cleaned and reconditioned, if approved.

2.03 REMOVABLE PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16-gauge, 0.0598 inch (1.52 mm) thick, matched, tight fitting,

stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Preformed Plastic Forms: Thermoplastic polystyrene form liner, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

C. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

D. Pan Type: Glass fiber, of size and profile indicated.

E. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; 2 inches (50 mm) thick.

F. Light weight forming material

1. Light weight forming material, Expanded Polystyrene (EPS) Board, shall conform to the requirement of ASTM Standard C-578. The EPS material shall have a minimum density of 1.25 lbs/cu ft. and a maximum density of 20 lbs/cu. ft. EPS boards shall be manufactured by PERMA “R” Products, Inc. of Grenada, MS, or approval equal.
2. Light weight forming material shall be designed to be left in place after the pouring of concrete as a permanent fixture of the structure.

2.04 FORMWORK ACCESSORIES

A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, break back dimension nominal to cone depth. Equal to Snap-Tie by Dayton Superior.

B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.

1. Composition: Colorless, reactive, water-based or solvent-based compound.
2. Do not use materials containing diesel oil or petroleum-based compounds.
3. VOC Content: In compliance with applicable local, State, and federal regulations.

C. Filler Strips for Chamfered Corners: maximum possible lengths.

D. Dovetail Anchor Slot: Galvanized steel, at least 22 gage, 0.0299 inch (0.76 mm) thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

E. Flashing Reglets: Galvanized steel, at least 22 gage, 0.0299 inch (0.76 mm) thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

G. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in *Division 05 12 00*.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

B. Surface material shall be laid out in as large units as practicable and shall be laid out in regular and symmetrical pattern as approved. Edges of units shall be tight-butted together with straight, clean joints: any appreciable space at joints to be 1/16". There shall be no bulges or defects deeper or higher respectively than 3/16" in four feet.

C. The Owner's Representative shall be notified when the concrete is ready for inspection. The formwork and/or excavation shall have the approval of the Owner’s Representative before placing of the concrete.

3.02 ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Obtain approval before framing openings in structural members that are not indicated on

drawings.

F. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

G. Coordinate this section with other sections of work that require attachment of components to formwork.

H. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect/Engineer before proceeding.

3.03 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.04 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

B. Locate and set in place items that will be cast directly into concrete.

C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

D. Position recessed anchor slots for brick veneer masonry anchors to spacing and intervals specified in Section 04 2613.

E. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

F. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are watertight.

G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

H. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

I. Set and build into the work anchorage devises and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.

J. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support types of screeds required.

3.05 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

B. Camber slabs and beams in accordance with ACI 301.

3.06 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in *Division 01 40 00* - Quality Requirements.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

C. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.07 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

D. Formwork not supporting concrete, such as sides of walls, columns, and similar parts of the Work, may be removed after cumulatively curing at not less than 10 degrees C (50 degrees F) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operation, and provided that curing and protection operations are maintained.

E. Reshores shall be placed as soon as practicable after stripping operations are complete but in no case later than practicable after stripping operations are complete and in no case later than the end of the day on which stripping occurs. Reshores shall be tightened to carry their required loads without overstressing the construction. Reshores shall remain in place until tests representative of the concrete being supported have reached the specified strength, and heavy loads due to construction operations have been removed.
F. Formwork supporting concrete may be removed four days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.
G. Forms: Clean form material suitable for reuse before erection. Form material will not be acceptable for reuse, if in opinion of the Architect/Engineer, it will not produce finished surface required by these specifications or called for on drawings.

DIVISION 03 20 00 – CONCRETE REINFORCING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reinforcing steel for cast-in-place concrete.
B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

A. *Division 03 10 00* - Concrete Forming and Accessories.
B. *Division 03 30 00* - Cast-in-Place Concrete.
C. *Division 04 20 00* - Unit Masonry: Reinforcement for masonry.
D. *Division 04 26 13* - Masonry Veneer: Spacing for veneer anchor reglets recessed in concrete.
E. *Division 04 29 00* - Engineered Unit Masonry: Reinforcement for engineered masonry.
F. *Division 26 05 23* - Grounding and Bonding for Electrical Systems: Grounding connection to concrete reinforcement.

1.03 REFERENCE STANDARDS

A. ACI 301 - Specifications for Structural Concrete.
B. ACI 315 - Manual of Standard Practice for Detailing Reinforcing Concrete Structures, including welded wire reinforcement; latest edition.
C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
D. ACI SP-66 - ACI Detailing Manual.
E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
F. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
H. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel.
I. CRSI (DA4) - Manual of Standard Practice.
J. CRSI (P1) - Placing Reinforcing Bars.
K. ICC - International Code Council (ICC); latest edition adopted,
   1. AC 133 "Proposed Revisions to the Acceptance Criteria for Mechanical Connector Systems for Steel Reinforcing Bars."

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
   1. Make shop drawings in accordance with *Division 03 30 00*, paragraph 1.05, Shop drawings. No reproduction of Contract Drawings for use as shop drawings will be permitted.
C. Reports: Submit certified copies of mill test report of reinforcement materials analysis

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301.
   1. Maintain one copy of each document on project site.
B. Provide Architect/Engineer with access to fabrication plants to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in

sufficient time to allow inspection.

C. Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver reinforcement to the job site bundled, tagged and marked. Use metal tags indicating bar size, lengths and other information corresponding to markings shown on placement diagrams.

B. Storage: Store reinforcement at the job site in a manner to prevent damage and accumulation of dirt and excessive rust.

PART 2 PRODUCTS

2.01 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
   1. Plain billet-steel bars.
   2. Unfinished.

B. Weldable Reinforcing Steel: ASTM A706/A706M, deformed low-alloy steel bars.
   1. Unfinished.

C. Stirrup Steel: ASTM A1064/A1064M steel wire, unfinished.

D. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.
   1. Form: Flat Sheets.
   2. WWR Style: 6 x 12-W12 x W5 (152 x 305-MW77 x MW32).

E. Reinforcement Accessories: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place:
   1. Use wire type bar supports or plastic chairs or supports complying with CRSI recommendations unless otherwise indicated. Do not use wood, brick or other unacceptable materials.
   2. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
   3. For footings or other concrete that will be in direct contact with earth, provide supports with either hot-dipped galvanized, stainless steel, plastic protected steel legs, precast concrete bar supports, or supports made entirely of plastic or other acceptable, inert polymer. Do not use wood, brick or other unacceptable materials.
   4. Tie Wire: Annealed, minimum 16-gauge, 0.0508 inch (1.29 mm).
   5. Provide stainless steel components for placement within 1-1/2 inches (38 mm) of exposed to view weathering surfaces.

2.02 RE-BAR SPLICING:

A. Coupler Systems: Mechanical devices for splicing reinforcing bars; capable of developing full-steel reinforcing design strength in tension and compression.

B. Dowel Bar Splicer with Dowel-Ins: Mechanical devices for connecting dowels; capable of developing full steel reinforcing design strength in tension and compression.

C. Taper Tie Hole Plug: Mechanical device for plugging tie holes; anchors optional flush or recessed grout.

2.03 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

B. Welding of reinforcement is permitted only with the specific approval of Architect/Engineer. Perform welding in accordance with AWS D1.4/D1.4M.

C. Locate reinforcing splices not indicated on drawings at point of minimum stress.
   1. Review locations of splices with Architect/Engineer.

D. General: Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with ACI Manual. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material. If clearances for reinforcing require hooks shorter than standard hooks, fabricator shall be responsible for providing shorter hooks, as required.

E. Unacceptable materials: Reinforcement with any of the following defects will not be permitted in the Work:
   1. Bar lengths, depths and bends exceeding specified fabrication tolerances.
   2. Bends or kinks not indicated on Drawings or Final Shop Drawings.

3. Bars with reduced cross-section due to excessive rusting or other causes.

PART 3 EXECUTION

3.01 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
B. Do not displace or damage vapor barrier.
C. Accommodate placement of formed openings.
D. Place reinforcement as follows with the following clear cover, unless noted otherwise on drawings:
   1. Below Grade
      a. Unformed 3”
      b. Formed 2”
   2. Slabs ¾”
   3. Exposed Columns 2”
   4. Exposed Beam/Girders 2”
   5. Exposed Slabs #5 and smaller, 2” otherwise.
      a. Top: 1 ½”
      b. Bottom: 1 ½”
E. Comply with applicable code for concrete cover over reinforcement.
F. Bond and ground all reinforcement to requirements of Section 26 0526.

3.02 INSPECTION

A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed, and correct conditions which would prevent proper and timely completion of the Work. Do not proceed with the work until unsatisfactory conditions have been corrected.
B. Inspection: Before placement of concrete, a representative of the Owner shall observe the placement of all reinforcing and give his approval.

3.03 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in *Division 01 40 00* - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.

3.04 SCHEDULES

A. Reinforcement For Superstructure Framing Members: Deformed bars, unfinished.
B. Reinforcement For Foundation Wall Framing Members and Slab-on-Grade: Deformed bars, unfinished.

3.05 INSTALLATION

A. General:
   1. Standards for details and methods of reinforcement placement and supports shall be in accordance with ACI requirements, CRSI Recommended Practices for Placing Reinforcing Bars, and as herein specified.
   2. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
   3. Position, support, and secure reinforcement and embedment against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal or plastic chairs, runners, bolsters, spacers, and hangers, as required and recommended by CRSI.
   4. Place reinforcement to obtain the minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports together with 16-gauge wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
   5. Install welded wire reinforcement in as long lengths as practicable. Lap adjoining pieces minimum of 8 inches. Welded wire fabric shall be continuously supported at 36” on center (O.C.) maximum.
   6. Provide sufficient numbers of supports and of strength to carry reinforcement. Do not place reinforcing bars more than 2" beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

7. All vertical reinforcing shall be doweled to footings or the structure below. Dowels shall be the same size and at the same spacing as the vertical reinforcing scheduled or detailed for the element above, unless otherwise indicated on the plans.
8. Dowels extending into footings shall terminate with a 90° standard ACI hook and shall extend to within 4-inches of the bottom of the footing.
9. All embedment and dowels shall be securely tied to formwork or the adjacent reinforcing prior to the placement of concrete.

B. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly tying wire. Reinforcement shall be spliced only as shown or noted in the plans or specifications. Splices at other locations may be used only when approved in writing by the structural engineer.
   1. Horizontal wall reinforcing shall terminate at ends of walls and openings into the far end of the jamb column with a 90-degree hook plus a 6-bar diameter extension, unless otherwise shown on the Plans.
   2. Lap horizontal bars as noted above or as shown on the Plans. Horizontal wall reinforcing shall be continuous through construction and control joints. Splices in horizontal reinforcement shall be staggered so that the splice laps do not occur along a single line. Splices in two curtains of reinforcing, where used, shall not occur in the same location. Splice laps shall not overlap other splices.
   3. Mechanical bar splices capable to develop at least 125 percent of the specified yield strength of the bar(s) may be used in lieu of contact lap splices where approved by the Architect/Engineer. Unless specifically noted otherwise, the connectors shall meet most restrictive of the requirements for a Type 2 as defined by ACI 318 Sections 21.2.6 or ICC Elevation Service AC 133. A submittal for the bar splices is required.

C. Welding: Reinforcing bars shall not be welded unless specifically indicated on the plans.

D. Detailing:
   1. Unless specific additional reinforcement around wall openings is shown on the drawings, provide additional reinforcing steel as follows:
      a. Walls with single layer of reinforcing steel located in center of wall:
         1) Provide additional reinforcing steel on each side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by the opening, or a minimum of 2-#5 bars. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.
         2) Provide diagonal reinforcing steel, 2-#5 x 4'-0" centered on the corners of the opening. Locate one #5 bar on either face of the center reinforcing steel.
      b. Walls with single layer of reinforcing steel located on one face of wall:
         1) Provide additional reinforcing steel on one side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by the opening, or a minimum of 2-#5 bars. These additional reinforcing bars to be in same plane as the interrupted reinforcing steel. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.
         2) Provide additional reinforcing steel on the other (unreinforced) side of the wall of 2-#5 horizontal or vertical at each edge of the opening. Extend 2 feet beyond the opening.
         3) Provide diagonal reinforcing steel, add 2-#5 x 4'-0" centered on the corners of the opening. Locate one bar in each face to each of the other layers of interior reinforcing.
      c. Walls with reinforcing steel located in both faces of the wall:
         1) Provide additional reinforcing steel on each side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by the opening for that particular face, or a minimum of 2-#5 bars in each face horizontal and vertical. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.
         2) Provide diagonal reinforcing steel, add 4-#5 x 4'-0" centered on the corners of the opening. Locate 2-#5 in each face interior to each of the other layers of reinforcing.

d. All recesses in concrete walls that interrupt the reinforcing steel shall be reinforced as if the recess were an opening.

2. All openings in slabs that are not shown on the structural Plans must be approved by the Engineer, in writing.
3. Embedded pipes, ducts, or conduits: The maximum diameter for embedded pipes, ducts, or conduits shall be 1/3 of the slab or wall thickness, spaced at a minimum of 3 conduit diameters on center.
4. Concrete Columns: All tied and spiral reinforced columns shall have ties or spirals spaced at one-half the required tie spacing for a distance of one-sixth of the column height above and below all floor (or beam) and roof (or beam) levels or any other point of lateral support, unless specifically indicated otherwise on the structural plans.

DIVISION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete building frame members.
B. Concrete for composite floor construction.
C. Elevated concrete slabs.
D. Floors and slabs on grade.
E. Concrete shear walls, elevator shaft walls, and foundation walls.
F. Joint devices associated with concrete work.
G. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.
H. Concrete curing.

1.02 RELATED REQUIREMENTS

A. *Division 03 10 00* - Concrete Forming and Accessories: Forms and accessories for formwork.
B. *Division 03 20 00* - Concrete Reinforcing.
C. *Division 07 92 00* - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
D. *Division 07 95 13* - Expansion Joint Cover Assemblies.

1.03 REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials 2010.
B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
C. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete
D. ACI 301 - Specifications for Structural Concrete
E. ACI 302.1R - Guide for Concrete Floor and Slab Construction
F. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete
G. ACI 305R - Hot Weather Concreting
H. ACI 306R - Cold Weather Concreting
I. ACI 308R - Guide to Curing Concrete
J. ACI 318 - Building Code Requirements for Structural Concrete and Commentary
K. ACI 347R - Guide to Formwork for Concrete
L. ASTM C33/C33M - Standard Specification for Concrete Aggregates
M. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
N. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
O. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete
P. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete
Q. ASTM C150/C150M - Standard Specification for Portland Cement
R. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete
S. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete
T. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
U. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete

V. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete
W. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
X. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
Y. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete 2010a
Z. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
AA. ASTM D994/D994M - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
BB. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
CC. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
DD. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting
EE. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers
FF. ASTM E1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers (Metric)
GG. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
HH. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
II. COE CRD-C 572 - Corps of Engineers Specifications for Polyvinylchloride Waterstop
II. NSF 372 - Drinking Water System Components - Lead Content

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Shop Drawings: The Contractor is to include as a part of his expense the cost of completely dimensioned concrete shop drawings embracing plans and details, bending diagrams, steel order list, placing diagrams, which service shall be furnished by a structural engineer licensed in the State of the project. No portion of the contract documents shall be reproduced and submitted as shop drawings. The shop drawings shall include the following:
    1. Foundation Plan - fully dimensioned, foundation schedule and details, wall sections, mechanical pad details, and related miscellaneous details. All details, plans and sections shall show reinforcing.
    2. Pier Details and Pier Schedule.
    3. Wall Elevations - fully dimensioned showing all thicknesses, reinforcing sections, form joints and all items that will leave visible marks or interruptions in the finished surfaces.
    4. Necessary Floor Plans - fully dimensioned plans with all depressions, rises, reinforcing steel, to include placement and accessories.
    5. Miscellaneous Items - All other reinforced concrete items shall be drawn at such scale as to give full dimensions, details and reinforcing with accessories as required.
C. All reinforcing shall be detailed, ordered, fabricated in accordance with the latest ACI Manual of Standard Practice for Detailing Concrete Structures and the CRSI Manual of Standard Practice.
D. Submit Shop Drawings to the Architect/Engineer for review, prior to release to field. Fabrication of reinforcing steel shall not be started until Drawings have been reviewed and stamped.
E. Prior to the placement of any concrete, design mixes for each type of concrete shall be submitted and approved by the testing laboratory. Mix designs shall include all required and shall include each type of aggregate and admixture to be used.
F. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
    1. For curing compounds, provide data on methods of removal in the event of incompatibility with floor covering adhesives.
G. Mix Design: Submit proposed concrete mix design.
    1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.

2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.

H. Samples: Submit samples of underslab vapor retarder to be used.

I. Samples: Submit two, 12 inch (305 mm) long samples of waterstops and construction joint devices.

J. Test Reports: Submit report for each test or series of tests specified.

K. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

L. Sustainable Design Submittals: If any wood or wood-based form materials, including supports, are permanently installed in the project, submit documentation required for sustainably harvested wood as specified in Section 01 6000 - Product Requirements.

M. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

N. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.
1. Maintain one copy of each document on site.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Follow recommendations of ACI 306R when concreting during cold weather.

D. For slabs required to include moisture vapor reduction admixture (MVRA), do not proceed with placement unless manufacturer's representative is present for the preinstallation meeting.

E. Prior to starting concrete operations the Contractor shall name his source of supply for concrete materials and shall submit representative samples and reports of quality tests for approval.

F. The Owner or Contractor will engage the services of a recognized independent testing laboratory to perform the following services, (in accordance with ASTM E 329-14a). See Division 01 General Requirements for the party responsible for choosing the laboratory and for the party, the Owner or Contractor, responsible for paying the cost of these testing services:
1. Make quality tests of materials, inspect the proportioning and mixing of all concrete for this project.
2. Slump Test, ASTM C-143, shall be taken as often as required to provide the specified consistency to concrete.
3. Cast and test a set of at least 6 cylinders for each day's pour or for each 100 cubic yards or fraction thereof. Cylinders shall be cured and tested in accordance with ASTM specifications for control tests. Cylinders shall be tested at 7 and 28 days. The Contractor shall provide insulated storage room with heat when necessary to store control cylinders, and a protected, fenced-in space for storage of field cylinders, which approximates the condition of curing of the concrete being sampled.

G. In the event that concrete tests fail to meet strength requirements of these Specifications, the Architect/Engineer may require at no additional cost to the Owner, tests in accordance with the "Standard Methods of Securing, Preparing and Testing Specimens of Hardened Concrete for Compressive and Flexural Strengths", ASTM C42, or order load tests in accordance with Chapter 20 of the ACI Building Code 318, to be made on the portions of the structure containing questionable concrete. Suitable appliances and methods of loading and measuring shall be provided by the Contractor. The portions of the structure which are found by the Architect/Engineer to contain defective concrete shall be removed and reconstructed in a manner satisfactory to the Architect/Engineer at the Contractor's expense. Concrete strength tests are to conform to Chapter 4 of the ACI Building Code 318-95.

H. The laboratory shall have free access to material stockpiles, batching and mixing plants, and job site. The Contractor shall provide adequate assistance to the laboratory in securing specified samples for tests.

I. Contractor shall give the Owner and laboratory reasonable notice before beginning any pours (at least 24 hours).

J. The laboratory shall supply a daily report of concrete and materials testing and inspection to the Architect/Engineer, Contractor and Owner.

K. Concrete batched away from the job and delivered in mixer or agitator trucks shall conform to

requirements of ASTM C94.

L. Authority and Duties of Laboratory Personnel:
Inspectors shall inspect the materials and the manufacture of concrete as specified and shall report to the Contractor, Architect/Engineer the progress thereof. Also, when it appears that the material furnished and the work performed by the Contractor fail to fulfill the specification requirements and contract, the inspector shall direct the attention of the Contractor to such failure or infringement. Such inspection shall not relieve the Contractor of any obligation to furnish acceptable materials or to provide the concrete quality in the structure that is in strict accord with plans and specifications. The inspectors are not authorized to revoke, alter, relax, enlarge, or release any portion of the work, but in case of any dispute arising between the inspector and the Contractor as to materials furnished or in the manner of performing the work the inspector shall have the authority to reject materials or suspend the work until the question at issue can be referred to the Architect/Engineer. The inspector shall not act as foreman or perform other duties for the Contractor. In no case shall any advice or omission on the part of the inspector relieve the Contractor of responsibility for completing the work in accordance with the plans and specifications and the fulfillment of the contract. The work will be inspected as it progresses, but failure to reject any defective work or materials shall not in any way prevent later rejection when such defect is discovered or obligate the Architect/Engineer for final acceptance. Any expense incidental to the investigation and determination of actual quality of any questionable material shall be borne by the Contractor.

M. Sampling and Testing:
1. All materials shall be samples, tested in accordance with appropriate ASTM Standards, and approved before inclusion in any work on this project.
2. Samples for testing shall be furnished by the Contractor.
3. Rejected material shall be immediately removed from the site.
4. Reinforcing steel shall be tested by heat in shops and by random sampling in the field when required by the Architect/Engineer or Owner.

1.06 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals, for additional warranty requirements.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Cement on the job shall be stored in watertight sheds or bins having floors off the ground.

B. Aggregate shall be handled and stored separately in a manner to prevent segregation or intrusion of foreign matter and in sufficient quantities to prevent wide fluctuation in moisture content.

C. Reinforcement when stored shall be raised off the ground on timbers.

1.08 JOB CONDITIONS

A. Concreting shall not be started during rain, sleet or snow and shall not be continued during such weather after having been started except long enough to come to a suitable cutoff point. Concrete placed during rain shall have the cement content increased in the amount of one sack of cement per cubic yard of concrete. All forms and earth forms shall be free of ice and frozen surfaces.

B. No concrete shall be poured unless temperature is 40 degrees and rising or unless special precautions are taken (approved by the Architect/Engineer). Adequate equipment shall be provided for heating the concrete materials and protecting the concrete during freezing and near freezing weather. All concrete shall have a temperature of between 50 degrees and 90 degrees F when depositing, and shall be maintained within this temperature range for at least 72 hours or for as much time as is required to insure the proper rate of curing. If the ambient temperature exceeds 90 degrees F, the mix shall be cooled by an appropriate method approved by the Architect/Engineer, such as icing the mixing water. Maintain uniform concrete temperature of succeeding batches placed. No salt or other chemicals shall be added to prevent freezing. The covering or other method used for temperature protection shall remain in place 24 hours after artificial heat is discontinued. The recommended Practice for Cold Weather Concreting" (ACI 306) and the "Recommended Practice for Hot Weather Concreting (ACI 305) shall be accepted as good practice.

PART 2 PRODUCTS

2.01 FORMWORK

A. Comply with requirements of *Division 03 10 00*.

2.02 REINFORCEMENT MATERIALS

A. Comply with requirements of *Division 03 20 00*.

2.03 CONCRETE MATERIALS

A. Cement:
   1. ASTM C150/C150M, Type I - Normal Portland type.
      a. Acquire cement for entire project from the same source.
   2. ASTM C595/C595M, Type IL – Portland-Limestone Cement type.
      a. Acquire cement for entire project from same source.

B. Fine and Coarse Aggregates shall conform to the following specifications:
   1. Coarse and fine aggregate shall conform to requirements of ASTM C33/C33M.
   2. All coarse aggregates shall be crushed limestone.
   3. The maximum size of coarse aggregate shall not be larger than 1", 1/5 of the narrowest dimension between forms of the member for which the concrete is to be used, nor larger than 3/4 the minimum clear spacing between reinforcing bars. Coarse aggregate for all concrete exposed to the weather shall be crushed limestone with a #57 gradation.
   4. Absorption in coarse aggregate shall not exceed 5%.
   5. The fineness modulus for fine aggregate used shall not vary more than 0.2 from the approved sample without approval. Fineness modulus to be 2.9.
   6. Each type of aggregate shall be from the same source for the entire project.

C. Lightweight Aggregate: ASTM C330/C330M.

D. Fly Ash: ASTM C618, Class C or F.

E. Fiber Reinforcement: Natural Cellulose Fiber complying with ASTM C1116/C1116M.

F. All concrete shall be normal weight unless specifically noted otherwise.
   1. Normal weight concrete shall be approximately 145 to 155 pounds per cubic foot.
   2. Lightweight concrete shall not exceed 110 pounds per cubic foot and shall be made of normal and normal weight fines.

G. Water shall be clean, fresh, and free from injurious amounts of oils, acids, alkali or organic material or other substances that may be deleterious to concrete or steel. ASTM C94 (potable).

H. Non-shrink grout shall be factory pre-mixed non-shrink, non-metallic grout containing mineral aggregate and shall require only the addition of water at the site. Grout shall be “EUCO NS” (non-metallic) as manufactured by the Euclid Chemical Company, “Masterflow 713” (non-metallic) as manufactured by Master Builders or approved equal. The grout shall conform to ASTM C-1107.

I. Waterstops shall be 9" Dumbbell type, Model No. 751 as manufactured by Greenstreak, at locations shown on drawings.

J. All materials shall be subject to approval. Any change of materials specified shall be submitted for approval in accordance with *Division 01 60 00* - Product Requirements and such change, if acceptable, shall be used only when specifically authorized in writing.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Air Entrainment Admixture: ASTM C260/C260M.

C. Water Reducing Agent: ASTM C494 Type A.

D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

E. Water Reducing Admixture: ASTM C494/C494M Type A.

2.05 ACCESSORY MATERIALS

A. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with ASTM C1107/C1107M.
   2. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch (13.7 MPa).
   3. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch (48 MPa).

2.06 BONDING AND JOINTING PRODUCTS

A. Epoxy Bonding System:

1. Comply with ASTM C881/C881M and of Type required for specific application.

B. Slab Isolation Joint Filler: 1/2 inch (13 mm) thick, height equal to slab thickness, with removable top section that will form 1/2 inch (13 mm) deep sealant pocket after removal.
   1. Material: ASTM D1751, cellulose fiber.
   2. Material: ASTM D1752, sponge rubber (Type I).
   3. Material: Closed-cell, non-absorbent, compressible polymer foam in sheet form.

C. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches (150 mm) on center; ribbed steel stakes for setting.
   1. Provide removable plastic cap strip that forms wedge-shaped joint for sealant installation.
   2. Height: To suit slab thickness.

D. Sealant and Primer: As specified in *Division 07 92 00*.

2.07 CURING MATERIALS, SEALING MATERIALS, AND HARDENING COMPOUND

A. Moisture-Retaining Sheet: ASTM C171.
   1. Curing paper, regular.
   2. Polyethylene film, white opaque, minimum nominal thickness of 4 mil, 0.004 inch (0.102 mm).
   3. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard (1.71 kg/sq m).

B. Water: Potable, not detrimental to concrete.

C. Curing Compounds: Comply with ASTM C309, Type 1, Class A. If concrete contains flyash, comply with ASTM C1315.
   1. Non-yellowing formulation where subject to ultraviolet light
   2. The compound shall be a dissipating resin type compound. The film must chemically break down in a two-to-four-week period after application.

D. Curing and Sealing Compound: Comply with ASTM C309, Type 1, Class A. If concrete contains flyash, comply with ASTM C1315. Where indicated, provide curing and sealing formulation with long-lasting finish that is resistant to chemicals, oil, grease, deicing salts, and abrasion.
   1. Non-yellowing formulation where subject to ultraviolet light

E. Curing and Hardening Compound: Comply with ASTM C309, Type 1, Class A. If concrete contains flyash, comply with ASTM C1315.
   1. Free of waxes, resins or oils;
   2. Penetrate concrete to change free lime to calcium silicate forming a permanently dense, hard surface.

F. The curing compound shall have test data from an independent laboratory indicating a maximum moisture loss of 0.030 grams per square cm when applied at a coverage rate of 300 square feet per gallon. Manufacturer's certification is required.

G. Curing compounds shall not be used on any surface against which additional concrete or other cementitious materials are to be bonded.

H. All curing compounds shall be delivered to the site of the work in the original container bearing the name of the manufacturer and the brand name. The compound shall be stored in a manner that prevents damage to the container and protects water-emulsion types from freezing.

I. Contractor must verify that curing compound used is appropriate for the specified floor finishing and compatible with materials used in the final application.

2.08 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations and with the requirements on S0.1:

B. Proportioning Structural Lightweight Concrete: Comply with ACI 211.2 recommendations and with the requirements on S0.1:

C. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect/Engineer for preparing and reporting proposed mix designs.

D. Concrete proportions shall be established in accordance with Section 5.3 of ACI 318-05 or alternatively, Section 5.4 of ACI 318-05. Submit test results and calculated standard deviation basis for design per Section 5.3 to Structural Engineer of Record with mix design submittal.

Proportion design mixes to produce determined required average strengths specified in Chapter 5 of ACI 318-05. All test results shall be dated within the past twelve months.

E. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
F. Fiber Reinforcement: Add to mix at rate of 1.5 pounds per cubic yard (0.89 kg per cu m), or as recommended by manufacturer for specific project conditions.
G. Fly Ash: Add fly ash to concrete mixes as indicated on the design drawings. Fly ash may be used as a partial replacement for Portland Cement consistent with ACI recommendations. Limit maximum fly ash content as part of total cementitious materials as indicated on the design drawings.
H. Concrete Types: Refer to design drawings for locations requiring concrete mix design types including compressive strength and aggregate type with options for fly ash and air entrainment.

2.09 MIXING

A. It shall be the Contractor's responsibility to furnish concrete which will conform to the quality and strength specified.
B. Transit Mixers: Comply with ASTM C94/C94M.
C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.
D. Admixtures:
    1. Calcium Chloride shall not be used.
    2. An approved air entraining agent (ASTM C260) shall be added at the mixer with accurate dispenser to produce entrained air 4-6% by volume in all concrete subject to weathering conditions.
    3. An approved water-reducing agent equal to those manufactured by Master Builder’s Inc., applied at the mixer with an accurate dispenser (ASTM 494 Type A).
    4. These and other admixtures shall be used only with specific approval. Tests for design mixes shall be made with the admixtures included.
E. The concrete shall be of such consistency and composition that it can be worked readily into the corners and angles of the forms and around reinforcement without permitting materials to segregate or free water to collect on the surfaces. Within the limiting requirements the Contractor shall adjust the consistency of the concrete as may be necessary to produce mixtures which will be placeable with reasonable methods of placing and compacting. The Contractor shall maintain on the job at all times adequate extra cement to be used at the rate of 1/2 sack cement per cubic yard concrete for each 2" slump increase for corrections due to wetness desired or obtained. No water shall be added to concrete except under the direct supervision of the Architect/Engineer or his appointed representative. Under no circumstances will the addition of more than 2 gallons of water per cubic yard of concrete be allowed at the site.
F. Measurement of Materials:
    1. Cement shall be measured by the sack or half-sack unless cement is weighed for each batch.
    2. Aggregates shall be proportioned separately by weight with proper compensation for weight of moisture; weighing equipment shall be accurate within 1%.
    3. Water shall be measured by an approved device capable of accurate measurement to one pint.
G. Concrete shall be from a single source for each major pour.

2.10 EXPANSION MATERIALS

A. Verify compatibility of joint filler with sealant specified.
B. All expansion joints on grade shall be pre-formed non-extruding resilient type, bituminous or bonded cork (ASTM D994/D994M or ASTM D1751).
C. Other expansion joints may comply with ASTM D1752 - "Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction."
D. Manufacturer’s certification and material submittal are required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which work of this Section will be performed. Correct

conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
B. Verify that forms are clean and free of rust before applying release agent.
C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
    1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
    2. Use latex bonding agent only for non-load-bearing applications.
E. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
F. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches (150 mm). Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
    1. Granular Fill Over Vapor Retarder: Cover vapor retarder with compactible granular fill as indicated on drawings. Do not use sand.
    2. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.
G. Concrete placing shall not be started until all necessary preparations have been completed and approval has been given. Preparations shall consist of completing all form work involved, placing all reinforcing steel, pipes, conduits, sleeves, hangers, anchors, fastening devices, waterproofing and such other work to be built into the concrete in the section to be poured, and any other preparations herein required for the concreting operations. Free water and any mud or debris shall be removed from forms and excavations to be occupied by concrete. Approved equipment shall be available on the job site for heating and/or protecting the concrete whenever freezing temperatures are likely to occur within curing period. Ice or chilled water may be required to control concrete temperature in hot weather to below 90 degrees F.
H. Slabs-on-grade shall be placed on a properly leveled and thoroughly compacted subgrade, equal to 95% maximum dry density. All subsoils for slabs shall be approved before placing concrete.
I. Approved equipment shall be provided for heating concrete materials and/or protecting the concrete whenever freezing temperatures are likely to occur within curing period.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
B. Install welded wire reinforcement in maximum possible lengths and offset end laps in both directions. Splice laps with tie wire.
C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.
B. Place concrete for floor slabs in accordance with ACI 302.1R.
C. Notify Architect/Engineer not less than 24 hours prior to commencement of placement operations.
D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
F. Concrete shall be conveyed from the mixer or transporting vehicle to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of materials or displacement of the reinforcing steel, and which will avoid rehandling. For ready-mix concrete in

an agitator truck, the elapsed time from mixer to placement shall not exceed 1-1/2 hours.

G. Concrete shall be deposited as nearly as practicable in its final position and shall have the qualities required. Concrete shall be deposited continuously in layers or sections of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause seams or planes of weakness. If sections cannot be placed continuously, proper construction joints shall be provided.

H. Concrete during and immediately after depositing shall be thoroughly compacted and worked around reinforcing and embedded fixtures and into all parts of forms by means of spades, rods and approved mechanical vibrators.
   1. For thin walls or inaccessible portions, concrete shall be worked into place by vibrating or other approved method: Care shall be taken so as not to work the concrete to the point where segregation occurs.

I. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

J. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING

A. Locate joints in slabs on grade as indicated on the drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
   1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.

D. Load Transfer Construction and Control Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for control joints.

E. Provide reinforcing dowels to match the reinforcing at the joint, unless noted otherwise.

F. Saw Cut Control Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch (5 mm) thick blade and cut at least 1 inch (25 mm) deep but not less than one quarter (1/4) the depth of the slab or as indicated on the drawings.

G. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

3.06 SEPARATE FLOOR TOPPINGS

A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.

B. Place required dividers, edge strips, reinforcing, and other items to be cast in.

C. Apply bonding agent to substrate in accordance with manufacturer's instructions.

D. Apply sand and cement slurry coat on base course, immediately prior to placing toppings.

E. Place concrete floor toppings to required lines and levels.
   1. Place topping in checkerboard panels not to exceed 20 feet (6 m) in either direction.

F. Screed toppings level, maintaining surface flatness of maximum 1:1000.

3.07 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. An independent testing agency, as specified in Section 01 4000, will inspect finished slabs for compliance with specified tolerances.

B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
   1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15, on-grade only.
   2. Under Raised Access Flooring: F(F) of 20; F(L) of 15, on-grade only.
   3. Under Thick-Bed Tile: F(F) of 20; F(L) of 15, on-grade only.
   4. Under Carpeting: F(F) of 25; F(L) of 20, on-grade only.
   5. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.

C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.

D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.

E. Correct defects by grinding or by removal and replacement of the defective work. Areas

requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.08 CONCRETE FINISHING

A. Finishing of Formed Surfaces
   1. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.
   2. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or surfaces that are covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp proofing, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.
   3. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
   4. Related Unformed Surfaces: At tops of walls, horizontal offset surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

B. Slab Finishes
   1. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, terrazzo, stone and other bonded applied cementitious finish flooring material, and as otherwise indicated. After placing slabs, plane surface to a tolerance not exceeding 1/2" in 10' when tested with a 10' straightedge. Slope surfaces uniformly to drains where required. After leveling; roughen surface before final set, with stiff brushes, brooms or rakes.
   2. Float Finish: Apply float finish, or wood float finish as described in ACI 302.1R, to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, and as otherwise indicated. After screening, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance not exceeding 1/4" in 10' when tested with a 10' straightedge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
   3. Trowel Finish: Apply trowel finish, or steel trowel finish as described in ACI 302.1R, to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, paint or other thin film finish coating system. After floating, begin final trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8" in 10' when tested with a 10' straightedge. Grind smooth surface defects which would telegraph through applied floor covering system.
   4. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Architect/Engineer Contracting Officer See Section 32 1313 - Concrete Paving. Provide a light, medium or coarse texture as directed on the drawings, defined as follows:
      a. Light Broom Finish: The texture imparted to the surface by simply dragging the broom

across the concrete without the application of any weight or downward pressure.

b. Medium Broom Finish: The texture imparted to the surface by dragging the broom across the concrete while applying enough downward pressure to create striations that are approximately 1/8 of an inch deep.

c. Coarse Broom Finish: The texture imparted to the surface by dragging a weighted broom across the concrete or while applying enough downward pressure to create striations that are approximately 1/4 of an inch deep.

3.09 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Curing Formed Surfaces: Cure formed concrete surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

C. Curing Slabs and Surfaces Not in Contact with Forms:

1. Initial Curing: Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days and then begin final curing.
2. Final Curing: Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

D. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than seven days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.

1. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.
2. Spraying: Spray water over floor slab areas and maintain wet.
3. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.

E. Final Curing: Begin after initial curing but before surface is dry.

1. Moisture-Retaining Sheet: Lap strips not less than 3 inches (75 mm) and seal with waterproof tape or adhesive; secure at edges. Maintain Moisture-Retaining Sheet for a period of 7 days.
2. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer as soon as final finishing operations are complete (within 2 hours).

F. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining sheet curings, by curing compound, and by combinations thereof, as herein specified.

G. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, damp proofing, membrane roofing, flooring, painting, and other coatings and finish materials, unless otherwise acceptable to Architect/Engineer. Final cure these concrete surfaces by use of moisture-retaining sheet, unless otherwise directed.

3.10 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in *Division 01 40 00* - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards (76 cu m) or less of each class of concrete placed.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.11 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect/Engineer and Contractor within 24 hours of test.
B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
C. Repair or replacement of defective concrete will be determined by the Architect/Engineer. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.
E. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect/Engineer. Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
F. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
G. Repair of Formed Surfaces: Remove and replace concrete having defective surface if defects cannot be repaired to satisfaction of Architect/Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
H. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
I. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plant to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.
J. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
K. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
L. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Architect/Engineer.
M. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same material to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finish concrete. Cure in same manner as adjacent concrete.
N. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact-dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours. Use epoxy-based mortar for structural repairs, where directed by the testing laboratory.
O. Repair methods not specified above may be used, subject to acceptance of Architect/Engineer.

3.12 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

3.13 SCHEDULE - CONCRETE TYPES AND FINISHES

A. Refer to design drawings for schedule of types of concrete such as footings, foundation walls, piers, slab-on-grade, walls, columns, structural slabs, etc., and requirements for concrete strength, aggregate and air entrainment, etc.

B. Refer to design drawings for schedule of concrete finishes for various types and locations of concrete.

DIVISION 03 35 11 – CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface treatments for concrete floors and slabs.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

B. *Division 03 30 00* - Cast-in-Place Concrete: Curing compounds that also function as sealers.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.06 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20-foot square area of floor being finished.

B. Do not finish floors until interior heating system is operational.

C. Maintain ambient temperature of 50 degrees F minimum.

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

A. Use at following locations: Where indicated on drawings.

2.02 COATINGS

A. High Gloss Clear Coating: Transparent, non-yellowing, water- or solvent-based coating.

1. Nonvolatile Content: 15 percent, minimum, when measured by volume.
2. Products:
   a. BRICKFORM; BRICKFORM Gem-Seal 100 VOC: www.brickform.com/#sle.
   b. Dayton Superior Corporation; AggreGloss® J25: www.daytonsuperior.com.
   c. Dayton Superior Corporation; Tuf Seal® J35: www.daytonsuperior.com.
   d. Dayton Superior Corporation; Ultra Seal EF: www.daytonsuperior.com.
   e. Dayton Superior Corporation; PENTRA-HARD® GUARD: www.daytonsuperior.com.
   f. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc: www.lmcc.com.
   g. The QUIKRETE Companies; QUIKRETE® Concrete & Masonry High Gloss Sealer: www.quikrete.com.
   h. SpecChem, LLC; Aqua Shine: www.specchemllc.com/sle.
   i. SpecChem, LLC; Crystal Shine: www.specchemllc.com/sle.
   j. SpecChem, LLC; Deco Shine Plus: www.specchemllc.com/sle.
   k. W. R. Meadows, Inc; Deck-O-Grip W/B (slip-resistant): www.wrmeadows.com/sle.
   l. W. R. Meadows, Inc; Decra-Seal W/B: www.wrmeadows.com/sle.
   m. Substitutions: See *Division 01 60 00* - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.03 COATING APPLICATION

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.

B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.

C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

DIVISION 04 10 00 - MASONRY

PART 1 GENERAL

EXTENT: It is preferred that all interior walls shall be CMU especially in assembly and high traffic areas except at Administration and Media Centers where alternative wall framing materials may be used such as metal framing and sheetrock. If metal wall framing and sheetrock are specified at educational spaces, sheetrock/ gypsum board shall be abuse resistant.
CORNERS: Special shape bullnose units shall be provided at corners of interior CMU wall construction and as needed for safety. The first course of CMU at top of finished slab shall be standard for base application such as vinyl, rubber, etc.

CONTROL JOINTS: At interior and exterior control joints, use paintable silicone or polyurethane sealant with vandal resistant characteristics. Provide backer rods prior to installation of control joints. MSCS recommends vertical control joints to not be located behind downspouts for maintenance concerns.

EXPANSION JOINTS: At all interior expansion joints greater than ½" use a vandal resistant metal covers. At exterior expansion joints, silicone coated compressible expansion joint materials are acceptable. Provide backer rods prior to installation of control joints.

CAVITY INSULATION: See *DIVISION 07 27 00* – CLOSED CELL SPRAY POLYURETHANE FOAM AIR BARRIER for continuous insulation applied in cavities. Contractor shall guarantee designed air space is maintained upon installation of spray foam. It is also recommended that a cavity wall rain screen system with fire-resistant insulation exterior of weather barrier or a vapor-permeable system for this climate zone be used.

WEEP VENTS: Specify aluminum inserts 16" OC staggered top and bottom and at windowsills and heads. Never specify sash cords or void joints.

THRU-WALL FLASHING: MSCS prefers 3oz solid copper that is permanently coated and bonded between two layers of asphalt-saturated glass fabric. **Use of EPDM thru-wall flashing is not permitted**. MSCS will consider on a case-by-case basis the installation of a complete, factory-assembled masonry wall cavity system. This system shall combine a flashing membrane with a mortar dropping collection drainage mat, weep tabs, drip edge and termination bar into a single, easy-to-install panel. Basis of Design shall be Total Flash by Mortar Net Solutions.

All through wall flashings at any place in the masonry construction that is interrupted by doors, windows, canopies, etc. shall be a bituminous copper material, heavy gauge.

EXTERIOR MASONRY CONSTRUCTION: MSCS prefers that privacy walls, brick column surrounds, etc. not use masonry as top course to minimize efflorescence and recommend use of prefinished waterproof caps such as pre- finished metal flashing when applicable. Architectural details shall be thoroughly reviewed and vetted to ensure no open brick cells are exposed. MSCS recommends darker color tones be used at grade level to avoid staining during final grading.

PROJECTIONS/ RECESSES: Masonry projections and recesses shall be a minimum of ¼". Details shall ensure that all horizontal surfaces have a slight slope to prevent water ponding on masonry surfaces.

SPECIALTY BRICK: MSCS prefers that specialty brick material and colors be minimal if used at all. Specifications shall include provisions for purchasing specialty brick from the same lot for color/ finish consistency.

GLAZED CMU: MSCS prefers no glazed concrete masonry units. Requests shall be reviewed on a case-by-case basis.

CLEANING: All masonry cleaners or high-pressure cleaning shall be approved by the brick-and-mortar manufacturers prior to cleaning and care shall be taken to protect the surrounding construction finishes, i.e. glazing, joint compounds, metal frames, etc.

1.01 SECTION INCLUDES

A. Mortar for masonry.
B. Grout for masonry.

1.02 RELATED REQUIREMENTS

A. *Division 04 20 00* - Unit Masonry: Installation of mortar and grout.
B. *Division 08 11 13.2* - Hollow Metal Doors and Frames: Products and execution for grouting steel door frames installed in masonry.

1.03 REFERENCE STANDARDS

A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata.
B. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2018.
C. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
D. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
E. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
F. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
G. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
H. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.
I. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
J. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.
K. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
L. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.
M. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2022.
N. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2023b.
O. ASTM E518/E518M - Standard Test Methods for Flexural Bond Strength of Masonry; 2022.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.
C. Reports: Submit reports on mortar indicating compliance of mortar to property requirements of ASTM C270 and test and evaluation reports per ASTM C780.
D. Reports: Submit reports on grout indicating compliance of component grout materials to requirements of ASTM C476 and test and evaluation reports to requirements of ASTM C1019.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Manufacturer's Installation Instructions: Submit packaged dry mortar manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
    1. Maintain one copy of each document on project site.

1.06 PRECONSTRUCTION TESTING

A. Testing will be conducted by an independent test agency, in accordance with provisions of *Division 01 40 00* - Quality Requirements.

B. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C780 recommendations for preconstruction testing.
   1. Test results will be used to establish optimum mortar proportions and establish quality control values for construction testing.

C. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.
   1. Test results will be used to establish optimum grout proportions and establish quality control values for construction testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.08 FIELD CONDITIONS

A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

B. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

C. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 MORTAR AND GROUT APPLICATIONS

A. Mortar Mixes:
   1. Project included Types M, S, and N mortar.
   2. Mortar mixes shall have the following minimum compressive strengths:
      a. 750 psi for Type N.
      b. 1800 psi for Type S.
      c. 2500 psi for Type M.
   3. Mortar mixes shall be used as follows:
      a. Type N for brick veneer and non-loadbearing partition walls.
      b. Type S for exterior walls and interior loadbearing walls.
      c. Type M for walls in contact with earth.

B. Grout Mix Designs:
   1. Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
      a. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
      b. Coarse grout for spaces with smallest horizontal dimensions greater than 2 inches.
   2. Engineered Masonry: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
      a. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
      b. Coarse grout for spaces with smallest horizontal dimensions greater than 2 inches.

2.02 MATERIALS

A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
   1. Type: Type N.

B. Packaged Dry Material for Mortar for Unit Masonry: Premixed masonry cement and mason's sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
   1. Type: Type N.

C. Packaged Dry Material for Mortar for Repointing: Premixed Portland cement, graded sand, and chemical admixtures complying with ASTM C91/C91M with the addition of water only.
   1. Color: Natural gray.

D. Packaged Dry Material for Mortar for Repointing: Premixed Portland cement, hydrated lime, and graded sand; capable of producing Type O mortar in accordance with ASTM C270 with the addition of water only.

1. Color: Standard gray.

E. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
   1. Type: Fine.

F. Portland Cement: ASTM C150/C150M.
   1. Type: Type I - Normal; ASTM C150/C150M.
   2. Color: Standard gray.

G. Masonry Cement: ASTM C91/C91M.
   1. Type: Type N; ASTM C91/C91M.
   2. Colored Mortar: Premixed cement as required to match Architect/Engineer's color sample.

H. Hydrated Lime: ASTM C207, Type S.

I. Quicklime: ASTM C5, non-hydraulic type.

J. Mortar Aggregate: ASTM C144.

K. Grout Aggregate: ASTM C404.

L. Water: Clean and potable.

M. Accelerating Admixture: Nonchloride type for use in cold weather.

N. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.

O. Bonding Agent: Latex type.

P. Integral Water Repellent Admixture: Polymeric liquid admixture added to mortar at the time of manufacture.
   1. Performance of Mortar with Integral Water Repellent:
      a. Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours:
         1) No water visible on back of wall above flashing at the end of 24 hours.
         2) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
         3) No more than 25 percent of wall area above flashing visibly damp at end of test.
      b. Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
      c. Compressive Strength: ASTM C1314; maximum 5 percent decrease.
      d. Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
   2. Use only in combination with masonry units produced with integral water-repellent admixture.

2.03 MORTAR MIXING

A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.

B. Maintain sand uniformly damp immediately before the mixing process.

C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

D. Do not use anti-freeze compounds to lower the freezing point of mortar.

E. If water is lost by evaporation, re-temper only within two hours of mixing.

2.04 GROUT MIXING

A. Mix grout in accordance with ASTM C94/C94M.

B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.

C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

D. Do not use anti-freeze compounds to lower the freezing point of grout.

PART 3 EXECUTION

3.01 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

B. Plug clean-out holes for grouted masonry with brick masonry units. Brace masonry to resist wet grout pressure.

3.02 INSTALLATION

A. Install mortar and grout to requirements of section(s) in which masonry is specified.

B. Work grout into masonry cores and cavities to eliminate voids.

C. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.

D. Do not displace reinforcement while placing grout.

E. Remove excess mortar from grout spaces.

3.03 GROUTING

A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of Contract Documents.
B. Perform all grouting by means of low-lift technique. Do not employ high-lift grouting.
C. Perform grouting by means of high-lift technique, except in locations that mandate use of low-lift grouting technique.
   1. Do not use high-lift grouting where size of cavities mandates use of fine grout.
D. Low-Lift Grouting:
   1. Limit height of pours to 12 inches.
   2. Limit height of masonry to 16 inches above each pour.
   3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
   4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
E. High-Lift Grouting:
   1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
   2. Brick: Limit pours to maximum 12 feet in height and 25 feet horizontally.
   3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
   4. Place grout for spanning elements in single, continuous pour.
F. High-Lifting Grouting is not allowed for all FEMA 361 projects.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 4000 - Quality Requirements.
B. Test and evaluate mortar in accordance with ASTM C780 procedures.
   1. Test with same frequency as specified for masonry units.
C. Test and evaluate grout in accordance with ASTM C1019 procedures.
   1. Test with same frequency as specified for masonry units.
D. Prism Tests: Test masonry and mortar panels for compressive strength in accordance with ASTM C1314, and for flexural bond strength in accordance with ASTM C1072 or ASTM E518/E518M; perform tests and evaluate results as specified in individual masonry sections.

DIVISION 04 20 00 – UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.
B. Clay facing brick.
C. Common brick.
D. Sand-lime face brick.
E. Ceramic glazed face brick.
F. Clay tile.
G. Reinforcement and anchorage.
H. Flashings.
I. Lintels.
J. Accessories.

1.02 RELATED REQUIREMENTS

A. *Division 03 20 00* - Concrete Reinforcing: Reinforcing steel for grouted masonry.
B. *Division 04 10 00* - Masonry Mortaring and Grouting.
C. *Division 06 10 00* - Rough Carpentry: Nailing strips built into masonry.
D. *Division 07 62 00* - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
E. *Division 07 92 00* - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel

Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2015b.

C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a (Reapproved 2014).
D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.
E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
F. ASTM C27 - Standard Classification of Fireclay and High-Alumina Refractory Brick; 1998 (Reapproved 2022).
G. ASTM C34 - Standard Specification for Structural Clay Loadbearing Wall Tile; 2023.
H. ASTM C56 - Standard Specification for Structural Clay Nonloadbearing Tile; 2022.
I. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale); 2023.
J. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2023.
K. ASTM C73 - Standard Specification for Calcium Silicate Brick (Sand-Lime Brick); 2023.
L. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2023.
M. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units; 2022.
N. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2023.
O. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2023a.
P. ASTM C212 - Standard Specification for Structural Clay Facing Tile; 2022.
Q. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2023.
R. ASTM C315 - Standard Specification for Clay Flue Liners and Chimney Pots; 2007 (Reapproved 2021).
S. ASTM C530 - Standard Specification for Structural Clay Nonloadbearing Screen Tile; 2023.
T. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale); 2022.
U. ASTM C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units; 2021.
V. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.
W. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
X. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2022.
Y. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2023b.
Z. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).
AA. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2015.
BB. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a, with Editorial Revision (2013).
CC. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2005.
DD. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
EE. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.
FF. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2005.
GG. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata.
HH. UL (FRD) - Fire Resistance Directory; current edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.
    1. Include calculations or selections from the manufacturer's prescriptive design tables that indicate compliance with the applicable building code and project conditions.
D. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.
E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
F. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
G. Test Reports: Concrete masonry manufacturer's test reports for units with integral water-repellent admixture.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
    1. Maintain one copy of each document on project site.
B. Fire Rated Assemblies: Comply with applicable code for protection requirements for fire rated masonry construction.
C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.
D. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.07 MOCK-UP

A. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar, accessories, structural backup, and flashings (with lap joint, corner, and end dam) in mock-up.
B. Locate where directed.
C. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
B. Handle and store ceramic glazed masonry units in protective cartons or trays. Do not remove from protective packaging until ready for installation.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
    1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
    2. Special Shapes: Provide non-standard blocks configured for corners.
        a. Provide special units with bullnose edge at exterior corner of exposed units at building interior. Provide standard CMU at first course above walking surface for wall base application.
    3. Load-Bearing Units: ASTM C90, normal weight.
        a. Hollow block, as indicated.
        b. Exposed Faces: Manufacturer's standard color and texture where indicated.
    4. Non-Loadbearing Units: ASTM C129.
        a. Hollow block, as indicated.
        b. Lightweight.
    5. Pre-Faced Units: ASTM C90, hollow block, with smooth resinous facing complying with ASTM C744.
        a. Colors and styles: As indicated on drawings.

2.02 BRICK UNITS

A. Manufacturers:
   1. Belden Brick: www.beldenbrick.com/#sle.
   2. Endicott Clay Products Co: www.endicott.com.
   3. General Shale Brick: www.generalshale.com.
   4. Meridian Brick LLC; Athens Architectural Series: www.meridianbrick.com/#sle.
   5. Substitutions: See *01 60 00* - Product Requirements.

B. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
   1. Color and texture to match Architect/Engineer's sample.
   2. Nominal size: As indicated on drawings.
   3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
   4. Compressive strength: As indicated on drawings, measured in accordance with ASTM C67/C67M.

C. Building (Common) Brick: ASTM C62, Grade SW; solid units.
   1. Nominal size: As indicated on drawings.
   2. Compressive strength: As indicated on drawings, measured in accordance with ASTM C67/C67M.

D. Hollow Facing and Building Brick: ASTM C652, Grade SW; Type HBS; Class H40V.
   1. Color and texture to match Architect/Engineer's sample.
   2. Nominal size: As indicated on drawings.
   3. Compressive strength: As indicated on drawings, measured in accordance with ASTM C67/C67M.

E. Sand-Lime Brick: ASTM C73, Grade SW.
   1. Color and texture to match Architect/Engineer's sample.
   2. Nominal size: As indicated on drawings.

F. Ceramic Glazed Face Brick: ASTM C126, Grade S (Select), Type I (single-faced units).
   1. Color and texture to match Architect/Engineer's sample.
   2. Nominal size: As indicated on drawings.
   3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn without chipping glaze to produce equivalent effect.
   4. Compressive strength: As indicated on drawings, measured in accordance with ASTM C67/C67M.

G. Fireclay Refractory Brick: ASTM C27 Class Super-duty; nominal size as indicated on drawings.
   1. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

2.03 CLAY TILE UNITS

A. Manufacturers:
   1. Elgin Butler Company: www.elginbutler.com.
   2. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Structural Clay Load-Bearing Wall Tile: ASTM C34, Grade LBX; end-construction type; plaster-base finish.
   1. Color and texture to match Architect/Engineer's sample.
   2. Nominal size: As indicated on drawings.
   3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

C. Structural Clay Non-Load-Bearing Tile: ASTM C56, Grade NB; plaster-base finish.
   1. Color and texture to match Architect/Engineer's sample.
   2. Nominal size: As indicated on drawings.
   3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

D. Structural Clay Non-Load-Bearing Screen Tile: ASTM C530, Grade SE; Type STX; smooth finish.
   1. Color and texture to match Architect/Engineer's sample.
   2. Nominal size: As indicated on drawings.
   3. Special shapes: Molded units as required by conditions indicated, unless standard units

can be sawn to produce equivalent effect.

E. Structural Clay Facing Tile: ASTM C212, Type FTS smooth; Standard Class; single-face units; end-construction type.
   1. Color and texture to match Architect/Engineer's sample.
   2. Nominal size: As indicated on drawings.
   3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

F. Ceramic Glazed Structural Clay Facing Tile: ASTM C126; Grade S (Select); Type I (single-faced units).
   1. Color and texture to match Architect/Engineer's sample.
   2. Size: 6T Series, thickness as indicated.
   3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn without chipping to produce equivalent effect.

G. Clay Flue Liner: ASTM C315, round or oval shape.
   1. Size: As indicated on drawings.
   2. Wall thickness: as advised by Engineer.

2.04 MORTAR AND GROUT MATERIALS

A. Mortar and Grout: As specified in *Division 04 10 10*.

B. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
   1. Color(s): As indicated on drawings.
   2. Manufacturers:
      a. Davis Colors: www.daviscolors.com.
      b. Lambert Corporation: www.lambertusa.com.
      c. Solomon Colors: www.solomoncolors.com/sle.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.

2.05 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:
   1. Blok-Lok Limited: www.blok-lok.com.
   2. Hohmann & Barnard, Inc: www.h-b.com/sle.
   3. WIRE-BOND: www.wirebond.com/#sle.
   4. Substitutions: See *01 60 00* - Product Requirements.

B. Reinforcing Steel: Type specified in *Section 03 20 00*; size as indicated on drawings; galvanized finish.

C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

D. Single Wythe Joint Reinforcement: ASTM A951/A951M.
   1. Type: Truss or ladder.
   2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
   3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.

E. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.

F. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
   1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
   2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
   3. Vertical adjustment: Not less than 3-1/2 inches.
   4. Seismic Feature: Provide lip, hook, or clip on end of wire ties to engage or enclose not less than one continuous horizontal joint reinforcement wire of 0.1483 inch diameter.

G. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.
   1. Manufacturers:
      a. ITW Commercial Construction North America; Teks Select Series:

www.ITWBuildex.com.
b. Substitutions: See *01 60 00* - Product Requirements.

2.06 FLASHINGS

A. Metal Flashing Materials: Copper, as specified in *Division 07 62 00*.
B. Combination Non-Asphaltic Flashing Materials - Stainless Steel:
1. Stainless Steel/Polymer Fabric Flashing: ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric.
2. Manufacturers:
a. Hohmann & Barnard, Inc; Mighty-Flash Stainless Flashing: www.h-b.com/sle.
b. WIRE-BOND; Bond-N-Flash: www.wirebond.com/#sle.
c. York Manufacturing, Inc; Multi-Flash SS: www.yorkmfg.com.
C. EPDM Flashing: ASTM D4637/D4637M, Type I, 0.040 inch thick.
1. Manufacturers:
a. Hohmann & Barnard, Inc: www.h-b.com/sle.
b. Substitutions: See *Division 01 60 00* - Product Requirements.
D. Factory-Fabricated Flashing Corners and End Dams: Stainless steel.
1. Manufacturers:
a. Mortar Net Solutions: www.mortarnet.com.
b. Substitutions: See *Division 01 60 00* - Product Requirements

2.07 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
1. Manufacturers:
a. Blok-Lok Limited: www.blok-lok.com.
b. Hohmann & Barnard, Inc: www.h-b.com/sle.
c. WIRE-BOND: www.wirebond.com/#sle.
d. Substitutions: See *01 60 00* - Product Requirements.
B. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
1. Full-Height Airspace Maintenance and Drainage Material: Mesh panels, fitted between masonry ties.
a. Manufacturers:
1) Advanced Building Products, Inc.: www.advancedbuildingproducts.com/sle.
2) CavClear/Archovations, Inc; CavClear Masonry Mat: www.cavclear.com/#sle.
3) Substitutions: See *01 60 00* - Product Requirements.
C. Weeps:
1. Type: Polyester mesh.
2. Manufacturers:
a. Blok-Lok Limited: www.blok-lok.com.
b. CavClear/Archovations, Inc: www.cavclear.com/#sle.
c. Hohmann & Barnard, Inc: www.h-b.com/sle.
d. WIRE-BOND: www.wirebond.com.
e. Substitutions: See *01 60 00* - Product Requirements.
D. Cavity Vents:
1. Type: Preformed aluminum vents with sloping louvers.
2. Manufacturers:
a. Blok-Lok Limited: www.blok-lok.com.
b. Hohmann & Barnard, Inc: www.h-b.com/sle.
c. WIRE-BOND: www.wirebond.com.
d. Substitutions: See *01 60 00* - Product Requirements.
E. Drainage Fabric: Polyester or polypropylene mesh bonded to a water and vapor-permeable fabric.
1. Manufacturers:
a. Advanced Building Products, Inc.: www.advancedbuildingproducts.com/sle.
b. Mortar Net Solutions: www.mortarnet.com.

c. York Manufacturing, Inc: www.yorkmfg.com.
d. Substitutions: See *01 60 00* - Product Requirements.

F. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.08 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
1. Masonry below grade and in contact with earth: Type S.
2. Exterior, loadbearing masonry: Type N.
3. Exterior, non-loadbearing masonry: Type N.
4. Interior, loadbearing masonry: Type N.
5. Interior, non-loadbearing masonry: Type N.

2.09 LINTELS

A. Concrete Lintels: ASTM C-1623; precast or formed-in-place reinforced concrete.
B. Masonry Lintels: Field-built or prefabricated, reinforced, grouted, bond-beam CMUs.
C. Steel Lintels: Refer to *Division 05 50 00* - Metal Fabrications

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.
B. Verify that related items provided under other sections are properly sized and located.
C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimensions. Form vertical and horizontal joints of uniform thickness.
C. Concrete Masonry Units:
1. Bond: Running.
2. Coursing: One unit and one mortar joint to equal 8 inches.
3. Mortar Joints: Concave.
D. Brick Units:
1. Bond: Running.
2. Coursing: Three units and three mortar joints to equal 8 inches.
3. Mortar Joints: Concave.
E. Clay Tile Units:
1. Bond: Running.
2. Coursing: One unit and one mortar joint to equal 8 inches.
3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
B. Lay hollow masonry units with face shell bedding on head and bed joints.
C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
D. Remove excess mortar and mortar smears as work progresses.
E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high-pressure cleaning methods.
F. Interlock intersections and external corners, except for units laid in stack bond.
G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
K. Isolate top joints of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 WEEPS/CAVITY VENTS

A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.
B. Install cavity vents in veneer and cavity walls at 32 inches on center horizontally below shelf angles and lintels and near top of walls and any other location where the wall cavity is interrupted.

3.07 CAVITY MORTAR CONTROL

A. Do not permit mortars to drop or accumulate into cavity air space or to plug weep/cavity vents.
B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturers to prevent mortar droppings from blocking weep/cavity vents.

3.08 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
C. Place continuous joint reinforcement in first and second joint below top of walls.
D. Lap joint reinforcement ends at a minimum of 6 inches.
E. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches on center.
F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.

3.09 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 36 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
C. Seismic Reinforcement: Connect veneer anchors with continuous horizontal wire reinforcement before embedding anchors in mortar.

3.10 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
    1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at non-masonry construction.
    2. Remove or cover protrusions or sharp edges that could puncture flashings.
    3. Seal lapped ends and penetrations of flashing before covering with mortar.
B. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.
C. Extend plastic, laminated, EPDM, and metal flashings to within 1/4 inch of exterior face of masonry.
D. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.11 LINTELS

A. Install loose steel lintels over openings.
B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.

1. Openings to 42 inches: Place two, No. 3 reinforcing bars 1 inch from bottom web.
2. Openings from 42 inches to 78 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
3. Openings over 78 inches: Reinforce openings as detailed.
4. Do not splice reinforcing bars.
5. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
6. Place and consolidate grout fill without displacing reinforcing.
7. Allow masonry lintels to attain specified strength before removing temporary support.

C. Maintain minimum 6 inches bearing on each side of opening.

3.12 GROUTED COMPONENTS

A. Lap splices at minimum 24 bar diameters.
B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
C. Place and consolidate grout fill without displacing reinforcing.
D. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.13 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.
B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
C. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.
D. Form expansion joint as detailed on drawings.

3.14 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
B. Install built-in items plumb, level, and true to line.
C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
    1. Fill adjacent masonry cores with grout minimum of 12 inches from framed openings.
D. Do not build into masonry, construction organic materials that are subject to deterioration.

3.15 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.
B. Maximum Variation from Alignment of Columns: 1/4 inch.
C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
G. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.16 CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.17 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
B. Clay Masonry Unit Tests: Test each variety of clay masonry in accordance with ASTM C67/C67M requirements, sampling 5 randomly chosen units for each 50,000 installed.
C. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.
D. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.18 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.
C. Clean soiled surfaces with cleaning solution.
D. Use non-metallic tools in cleaning operations.

3.19 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

DIVISION 04 30 00 – CAST STONE MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Architectural cast stone.

1.02 RELATED REQUIREMENTS

A. *Division 04 05 11* - Masonry Mortaring and Grouting: Mortar for setting cast stone.
B. *Division 04 20 00* - Unit Masonry: Installation of cast stone in conjunction with masonry.
C. *Division 07 92 00* - Joint Sealants: Sealing joints indicated to be left open for sealant.

1.03 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
C. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2014.
D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
E. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
F. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
G. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
H. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).
I. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2023.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Test results of cast stone components made previously by the manufacturer.
   1. Include one copy of ASTM C1364 for Architect/Engineer's use.
C. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.
D. Mortar Color Selection Samples.
E. Verification Samples: Pieces of actual cast stone components not less than 6 inches square, illustrating range of color and texture to be anticipated in components furnished for the project.
F. Full-Size Samples, For Review:
   1. Basic Shapes: One of each.
   2. Accent, Trim and Specialty Shapes: One of each.
G. Source Quality Control Test Reports.
H. Manufacturer's Qualification Data: Documentation showing compliance with specified requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. A firm with a minimum of 5 years' experience producing cast stone of types required for projects.
   2. Current producer member of the Cast Stone Institute or the Architectural Precast Association.
   3. Manufacturer's production facility currently holds a Plant Certification from the Cast Stone Institute or the Architectural Precast Association.
   4. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.
B. Installer Qualifications: Company specializing in performing work of the type specified and with

at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.
B. Number each piece individually to match shop drawings and schedule.
C. Store cast stone components and installation materials in accordance with manufacturer's instructions.
D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.
E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.
F. Store mortar materials where contamination can be avoided.
G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Architectural Cast Stone:
   1. Any current producer member of the Architectural Precast Association.
   2. Any current producer member of the Cast Stone Institute.
   3. Premier Stoneworks, LLC: www.premier-stoneworks.com/#sle.
   4. Approved Equal.
   5. Substitutions: See *01 60 00* - Product Requirements.

2.02 ARCHITECTURAL CAST STONE

A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural granite, complying with ASTM C1364.
   1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
   2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
   3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet.
   4. Remove cement film from exposed surfaces before packaging for shipment.
B. Shapes: Provide shapes indicated on drawings.
   1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch or length divided by 360, whichever is greater, but not more than 1/4 inch.
   2. Unless otherwise indicated on drawings, provide:
      a. Wash or slope of 1:12 on exterior horizontal surfaces.
      b. Drips on projecting components, wherever possible.
      c. Raised fillets at back of sills and at ends to be built in.
C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI CODE-318.
   1. Pieces More than 24 inches in Any Dimension: Provide full length two-way reinforcement of cross-sectional area not less than 0.25 percent of unit cross-sectional area.

2.03 MATERIALS

A. Portland Cement: ASTM C150/C150M.
   1. For Units: Type I, white or gray as required to match Architect/Engineer 's sample.
   2. For Mortar: Type I or II, except Type III may be used in cold weather.
B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.
C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.
D. Admixtures: ASTM C494/C494M.
E. Water: Potable.
F. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.
G. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel of type and size as required for conditions.
H. Shelf Angles and Similar Structural Items: Hot-dip galvanized steel per ASTM A123/A123M, of

shapes and sizes as required for conditions.

I. Mortar: Portland cement-lime, as specified in *Division 04 10 10*; do not use masonry cement.

J. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturers for use on cast stone and adjacent masonry materials.

PART 3 EXECUTION

1.01 EXAMINATION

A. Examine construction to receive cast stone components. Notify Architect/Engineer if construction is not acceptable.

B. Do not begin installation until unacceptable conditions have been corrected.

1.02 INSTALLATION

A. Install cast stone components in conjunction with masonry, complying with requirements of *Division 04 20 00*.

B. Mechanically anchor cast stone units indicated; set remainder in mortar.

C. Setting:

1. Drench cast stone components with clear, running water immediately before installation.
2. Set units in a full bed of mortar unless otherwise indicated.
3. Fill vertical joints with mortar, except as indicated below.
4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

1.03 TOLERANCES

A. Joints: Make all joints 3/8 inch, except as otherwise detailed.

1. Rake mortar joints 3/4 inch for pointing.
2. Remove excess mortar from face of stone before pointing joints.
3. Point joints with mortar in layers 3/8 inch thick and tool to a slight concave profile.
4. Leave the following joints open for sealant:
   a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
   b. Joints in projecting units.
   c. Joints between rigidly anchored units, including soffits, panels, and column covers.
   d. Joints below lugged sills and stair treads.
   e. Joints below ledge and relieving angles.
   f. Joints labeled "expansion joint" or aligned with "BCJ" or "brick control joint".

B. Installation Tolerances:

1. Variation from Plumb: Not more than 1/8 inch in 10 feet or 1/4 inch in 20 feet or more.
2. Variation from Level: Not more than 1/8 inch in 10 feet or 1/4 inch in 20 feet, or 3/8 inch maximum.
3. Variation in Joint Width: Not more than 1/8 inch in 36 inches or 1/4 of nominal joint width, whichever is less.
4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

1.04 REPAIR

A. Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet.

1. Repair with matching touch-up material provided by the manufacturer and in accordance with manufacturer's instructions.
2. Repair methods and results subject to Architect/Engineer 's approval.

1.05 CLEANING

A. Keep cast stone components clean as work progresses.

B. Clean completed exposed cast stone after mortar is thoroughly set and cured.

1. Wet surfaces with water before applying cleaner.
2. Apply cleaner to cast stone in accordance with manufacturer's instructions.
3. Remove cleaner promptly by rinsing thoroughly with clear water.
4. Do not use acidic cleaners.

1.06 PROTECTION

A. Protect completed work from damage.

B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

DIVISION 05 00 00 – METALS AND FABRICATIONS

PART 1 GENERAL

All exposed Structural Steel shall be primed where rust has occurred during exposure to weather.

RAILINGS: Exterior rails finish shall be the most economical and maintenance- free finish. MSCS recommends stainless steel or aluminum finish for interior handrails. Painted handrails are not desired due to finishing, longevity and maintenance. These finishes shall include but not be limited to stainless steel, brushed aluminum, powder coating, factory finish or primed steel with epoxy painted finish. Railing installation shall not be surface mounted except only when approved by MSCS PM for special conditions. All exposed steel/ metal with finished coatings shall have a minimum 5-year warranty.

INTERIOR METAL STAIRS: Shall be concrete pan only. Stair stringers shall be steel channels or tubing.

LADDERS: Provide painted metal ladder to roof with locked scuttle/roof hatch. Provide fixed painted steel ladders at roof elevation changes. Designer is to determine minimum required height to provide fall cage and intruder access protection such as gate and lock.

EXPOSED STRUCTURAL STEEL: MSCS recommends that all structural steel/ metal be hot-dipped galvanized or powder coated. All exposed metal shall have compatible protection finish applied such as paint to protect from the elements. Colors shall be reviewed and approved by the Designer and Owner.

DIVISION 05 12 00 – STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural steel framing members.
B. Work shall include but not be limited to:
   1. Beams, columns, and hangers
   2. Channels, purlins, and angle girts
   3. Cap plates, anchor bolts
   4. Connections, field and shop welded and bolted
   5. Bracing
   6. Shop drawings
   7. Shop prime coat and field touch-up
   8. Base plates and anchor bolts
   9. Grouting under base plates.
C. Work not included but specified elsewhere:
   1. Stairs and handrail
   2. Steel roof and floor deck
   3. Field painting (except for touch-up)
   4. Ladders (steel)
   5. Steel bar joists

1.02 RELATED REQUIREMENTS

A. *Division 09 90 00* - Painting and Coating.
B. *Division 09 91 13* - Exterior Painting.
C. *Division 09 91 23* - Interior Painting.

1.03 PRICE AND PAYMENT PROCEDURES

A. See *Division 01 23 00* - Unit Prices, for additional unit price requirements.
B. Structural Steel Framing:
   1. Basis of Measurement: By the ton.
   2. Basis of Payment: Includes structural members fabricated, placed, and anchored.

1.04 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
B. AISC (MAN) - Steel Construction Manual; 2023, with Errata (2024).
C. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2022.
D. AISC 360 - Specification for Structural Steel Buildings; 2010.

E. ASTM A1 - Standard Specification for Carbon Steel Tee Rails; 2000 (Reapproved 2018).
F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
H. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2013.
I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
J. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
K. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use; 2010.
L. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
M. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
N. ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding; 2022.
O. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality; 2019.
P. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2007a (Reapproved 2014).
Q. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.
R. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2014.
S. ASTM A759 - Standard Specification for Carbon Steel Crane Rails; 2021.
T. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.
U. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.
V. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.
W. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.
X. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2023.
Y. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.
Z. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
AA. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.
BB. ASTM F959/F959M - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series; 2017a.
CC. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
DD. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
EE. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
FF. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
GG. ITS (DIR) - Directory of Listed Products; current edition.
HH. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.
II. SSPC-SP 3 - Power Tool Cleaning; 1982 (Ed. 2004).
JJ. American Institute of Steel Construction (AISC) “Specification for Structural Steel Buildings, AISC 360-10.

KK. AISC “2004 RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts”
LL. AISC 341-10, “Seismic Provision for Structural Steel Buildings including Supplement No.1”, dated 2006
MM. AISC “Code of Standard Practice for Steel Buildings and Bridges,” March 18, 2005, with the following exclusions: Section 1.5.1, Section 4.4 - second sentence, Section 7.5.4.
NN. American National Standards Institute (ANSI).
OO. American Iron and Steel Institute (AISI).
PP. Steel Structure Painting Council (SSPC).
QQ. Occupational Safety and Health Act (OSHA).

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Submit erection drawings, detailed shop drawings and schedules, properly checked and coordinated with other parts of the construction. No reproduction of Contract Drawings for use as shop drawings will be permitted.
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Connections not detailed.
   3. Indicate cambers and loads.
   4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
   5. These drawings shall show type of steel for each member, location and identification mark of each member; dimensions; size and weight of members; location of shop and field connections; weld details; welded sequence; and painting requirements. (The Welding symbols used shall be as adopted by the American Welding Society.)
   6. No splices in members will be permitted except where fully detailed on the shop drawings, approved by the Architect/Engineer.
   7. These drawings shall show all requirements such as (1) temporary members required for erection, including connections; and (2) all openings referred to under “fabrication” in this section.
   8. Except as otherwise noted, the approval of shop drawings will be for size and arrangement of principal and auxiliary components and strength of connections. Any error in dimensions shown on the shop drawings shall be the responsibility of the Contractor.
C. Product Data: Provide data on specified products, including paints and coatings, describing physical and performance characteristics. Include verification that the product used does not exceed the limits established in the EQ VOC Table in Section 01 81 13 TN High-Performance Building Requirements.
D. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
E. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
F. Fabricator Test Reports: Comply with ASTM A1011/A1011M.
G. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
H. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.
I. Submit a description of the methods, sequence of erection, and type of equipment proposed for erecting the structural steel work.
J. Fabrication of any material, cutting of any holes, or performance of any work shall not proceed until shop drawings have been approved by the Architect/Engineer.
K. Certified copies, in triplicate, of mill test reports, including names and locations of mills and shops and analysis of chemical and physical properties of steel to be used on this project, shall be submitted to the Architect/Engineer before delivery to the job site.
L. Manufacturer’s certification, in triplicate, of bolt washers, nuts, and filler metal for welding shall be submitted to the Architect/Engineer.
M. Furnish an affidavit certifying that throughout fabrication the identification of steel having a specified minimum yield point exceeding 36,000 psi has been maintained in accordance with ASTM A6/A6M and AISC recommended practice for identification of high strength steel during fabrication.

N. Unless otherwise agreed upon by the Architect/Engineer in writing, the Architect/Engineer shall have fifteen (15) working days, from the day the shop drawings are received, in which to review structural steel shop drawings.

1.06 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
B. Structural steel members designated as Architecturally exposed structural steel (AESS) to also comply with *Division 05 12 00*.
C. Maintain one copy of each document on site.
D. Fabricator: Company specializing in performing the work of this section with minimum 10 years of documented experience.
E. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
    1. The contractor shall have completed projects of similar scope and have adequate facilities to meet production requirements and have satisfactory capabilities to maintain proper job progress. It is imperative that steel is delivered to the site on schedule and in the sequence required for efficient erection on schedule.
    2. The Fabricator and Erector shall have in place and maintain a quality assurance program, meeting the approval of the Architect/Engineer, to ensure that the work is performed in accordance with the requirements referenced in the AISC Code of Standard Practice, the AISC Specification for Structural Steel Buildings, and these Contract Documents. Certification under the AISC Quality Certification Program for Complex Building Structures for fabricators and/or under the AISC Erector Certification Program for erectors is recommended.
    3. Certification of Welders: All shop and field welding shall be executed by AWS Certified welders who have been specifically certified for the type of work to be performed. Certifications shall be considered current if dated within the past 12 months. Welders will be considered certified if they have been certified by AWS and their work records are current within every 6-month period, thereafter, as required by AWS. Certifications and records must comply with AWS standards. Certifications and appropriate records must be provided to the Architect/Engineer prior to beginning work.
F. Erector: Company specializing in performing the work of this section with minimum 10 years of documented experience.
G. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
H. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel."
I. Comply with applicable provisions of the following specifications and documents:
    1. AISC's 303-05 "Code of Standard Practice for Steel Buildings and Bridges."
    2. AISC's 360-05 "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design," and including the "Commentary of the AISC Specification," and the current supplements.
    3. RCSC's "Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts."

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handle, transport and stack all materials carefully to prevent deformation or damage. Store all structural steel members carefully on substantial timbers and blocking, so arranged that the steel will be free from the earth and properly drained, preventing any splattering with dirt or accumulation of water in or about the steel. Take care to prevent the accumulation of mud, or other foreign matter on the steel. Such accumulation shall be completely removed prior to erection.
B. Deliver all steel pieces to the site in the sequence required for efficient erection on schedule. The importance of timely sequencing of steel deliveries for on-schedule steel erection is emphasized due to the nature of this fast-track project and the impact on all following construction trades and Owner daily operations.

C. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
D. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.08 COORDINATION

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
B. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that show primers and topcoats are compatible with one another.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Angles and Plates: ASTM A36/A36M.
B. Steel W Shapes and Tees: ASTM A992/A992M.
C. Rolled Steel Structural Shapes: ASTM A992/A992M.
D. Steel Shapes, Plates, and Bars: ASTM A242/A242M high-strength, corrosion-resistant structural steel.
E. Steel Shapes, Plates, and Bars: ASTM A529/A529M high-strength, carbon-manganese structural steel, Grade 50.
F. Crane Rails: ASTM A1, end hardened and ultrasonic tested; cross section and length as indicated on drawings.
G. Crane Rails: ASTM A759, high strength alloy, head-hardened, heat-treated, ends hardened, ends chamfered, and ends prepared for welding; cross section and length as indicated on drawings.
H. Steel Plates and Bars: ASTM A572/A572M, Grade 50 (345) high-strength, columbium-vanadium steel.
I. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
J. Hot-Formed Structural Tubing: ASTM A501/A501M, seamless or welded.
K. Steel Bars: ASTM A108 Grade 60.
L. Steel Plate: ASTM A514/A514M.
M. Steel Sheet: ASTM A1011/A1011M, Designation SS, Grade 30 hot-rolled, or ASTM A1008/A1008M, Designation SS, Grade 30 cold-rolled.
N. Pipe: ASTM A53/A53M, Grade B, Finish black.
O. Sag Rods: ASTM A36/A36M.
P. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M Class C.
Q. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.
R. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.
S. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436/F436M Type 1 washers.
T. Headed Anchor Rods: ASTM A 307 Grade C, plain.
U. Load Indicator Washers: Provide washers complying with ASTM F959/F959M at connections requiring high-strength bolts.
V. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
W. Sliding Bearing Plates: Teflon coated.
X. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities

having jurisdiction.

Y. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

Z. Structural steel W-shapes shall be newly rolled steel conforming to ASTM A992-04a or ASTM 572-04 with special requirements, Grade 50 or ASTM A913-04, Grade 50 Steel. Other structural steel shapes and plates shall be newly rolled steel conforming to ASTM A36/A-04 or ASTM A572-04, Grade 50. Structural tubes ASTM A500-07, Grade B with yield strength = 46 KSI. Structural pipes ASTM A53-07, Grade B with yield strength = 35 KSI.

AA. Structural shapes and plates shall be fabricated from newly rolled (milled) one-piece sections without splices, unless specifically noted otherwise on the structural contract drawings.

BB. High strength bolts shall conform to ASTM A325 (or ASTM A1852 - twist-off) or ASTM A490, as shown on the drawings. Nuts shall conform to ASTM A563 and hardened washers shall conform to ASTM F436, unless specifically indicated otherwise.

CC. Anchor bolts/rods shall conform to ASTM A36/A36M, ASTM F1554 - Grades 36, 55, and 105, ASTM A354, or ASTM A449 with ASTM A563 Heavy Hex nuts and ASTM F436 hardened washers, Grade A, as shown on drawings.

DD. All welding shall be performed using E70XX electrodes, except E60XX series electrodes may be used for steel decking. All electrodes shall have a Sharpy V-notch toughness rating equal to or exceeding 20 ft-lbs. at (-20) degrees Fahrenheit.

EE. Deformed Bar Anchors (DBA): All DBA'S shall comply with ASTM A496

FF. Headed Stud Anchors (HSA): Manufacture all HSA's in conformance with ASTM A108 with dimensions complying with AISC Specifications.

GG. Provide all column sections with a ½" (min.) thick full size cap plate, unless noted otherwise.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Space shear stud connectors as indicated on the drawings.

C. Continuously seal joined members by continuous welds. Grind exposed welds smooth.

D. Fabricate connections for bolt, nut, and washer connectors.

E. Develop required camber for members.

F. Provisions for attachment of other materials: punch and drill steel for attachment of other materials indicated on the drawings or noted in the specification to be attached to the steel.

G. Connections for structural steel members shall comply with these specifications and the structural contract drawings, unless specific written approval is given by the Structural Engineer of record.

H. Shop Connections: All shop fabricated connections shall be welded (and/or bolted) using bearing type bolts or friction type, high strength bolts, installed by the modified turn-of-the-nut method, unless otherwise indicated.

I. Welding:
   1. Shop welding shall be done by either metal-arc welding or submerged arc-welding.
   2. Groove welds shall have complete penetration unless otherwise noted on the drawings.
   3. Finish contact surfaces on all column splices and other compression splices shown on the drawings shall meet requirement of ASTM A6/A6M Table 24.
   4. Minimum Welds: All intersecting steel shapes that are not bolted shall be connected by a fillet weld, all around, unless specifically noted otherwise. All welds shall conform to AISC Specifications. Fillet weld sizes that are not shown shall be 1/16" less than the thinnest of the connected parts for thicknesses ¼" and larger. Fillet welds on pieces less than ¼" shall be of the same size as the thinnest of the connected parts.
   5. Reinforcing Bars: Do not weld reinforcing bars, except as specifically detailed in the contract documents. In such cases, use only AWS standards. Do not substitute reinforcing bars for deformed bar anchors (DBA's), machine bolts, or headed stud anchors (HSA's).

J. Oxygen Cutting: Manual oxygen cutting shall be done only with a mechanically guided torch. Alternatively, an unguided torch may be used provided that cut is not with ¼" of the finished dimension and the final removal is completed by chipping or grinding to provide a surface quality equal to that of the base metal edges. The use of oxygen-cut holes for bolted connections will not be permitted; components prepared in this manner will be rejected.

K. No oversize holes may be used on bolted connections except where specifically approved.

L. Identification: Structural steel members shall have assigned positions and identification mark or symbol, plainly indicated thereon near one end. Marks shall agree with those given on the shop drawings and erection drawings relating to or calling for the members. Marking should be accomplished in such a way that identification mark will not bleed through finish paint.

2.03 FINISH

A. Prepare structural component surfaces in accordance with SSPC-SP 3 10.
B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.
C. Galvanize structural steel members to comply with ASTM A123/A123M. Provide minimum 1.7 oz/sq ft galvanized coating.
D. Steel to be Painted:
    1. Generally, the structural steel shall receive one shop coat of primer paint. See *Division 09 90 00* - Painting and Coating.
    2. Thoroughly clean steel to be painted.
    3. Surfaces requiring paint shall be painted only to within two inches of any field weld or friction type, high strength bolted connection. If for any reason the surface to be field welded or bolted is painted, such paint shall be completely removed to within the stated limits before field welding or bolting.
E. Steel to be Left Unpainted:
    1. Contact surfaces (e.g., high strength bolted connections and welded connections).
F. Shop Painting:
    1. After steel has been properly prepared as specified above, apply primer paint to dry steel surfaces by brush, spray or roller, insuring no running or sagging in accordance with manufacturer's directions.
    2. The coverage rate per coat shall not be more than 400 square feet per gallon resulting in a wet film thickness of four (4) mils and providing a minimum dry film thickness of two (2) mils.

2.04 SOURCE QUALITY CONTROL

A. Provide shop testing and analysis of structural steel as required per the Quality Assurance Plan.
B. Welded Connections: Visually inspect all shop-welded connections and test at least _____ percent of welds or as indicated on the drawings, using one of the following:
    1. Radiographic testing performed in accordance with ASTM E94/E94M.
    2. Ultrasonic testing performed in accordance with ASTM E164.
    3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
    4. Magnetic particle inspection performed in accordance with ASTM E709.
C. The contractor shall maintain and pay for his own quality control and inspection of all shop work. Records of tests shall be readily available for examination by the Architect/Engineer or his designated representative and copies of which shall be turned over to the Architect/Engineer upon request.
D. Acceptance at the shop shall not prevent final rejection at the job site if work is found to be defective in any way.
E. Unless otherwise noted, when compliance with the referred specifications, etc., or this specification, is specified for materials or a manufactured or fabricated product, the contractor, if requested, shall furnish the Architect/Engineer with an affidavit from the manufacturer or fabricator certifying that the material product delivered to the project meets the requirements of the contract document.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to:
    1. AISC 303 and AISC 360
    2. OSHA Construction Industry Standards (29 CFR 1926)
    3. Specified requirements.
    4. AISC "Code of Standard Practice for Steel Buildings and Bridges".

B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
C. Field weld components and shear studs indicated on shop drawings.
D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
E. Do not field cut or alter structural members without approval of Architect/Engineer.
F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
G. Field connections shall be one of the following:
    1. Bolted connections using ASTM A307 bolts brought up to and beyond snug tight after faying surfaces are in contact. A307 to be used only in miscellaneous steel members.
    2. High strength steel bolts conforming to ASTM A325.
        a. Installation shall be performed by using pneumatic powered impact wrenches with sufficient capacity and an adequate supply of compressed air.
        b. Installation shall be performed in accordance with the turn-of-the-nut method outlined in the AISC “Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts”, with the following modifications:
            1) Use a hardened washer under either the bolt head or nut, whichever is turned in tightening.
            2) Qualifications of high strength bolting procedures and operations shall be as specified under “Qualifications” in this section.
        c. Pre-calibrated bolts similar and equal to Le June bolts may be substituted. Submit sample and manufacturer qualifications for approval by Architect/Engineer.
    3. Welding:
        a. Field welding shall be executed in accordance with all the requirements under “Fabrication: Welding” in this section excepting those requirements which manifestly apply to shop conditions only.
        b. Field welding shall be accomplished by using either the shielded metal arc (SMAW) or the flux-cored arc (FCAW) welding process.
H. Special provisions for full penetration welds used in moment frames: These special provisions shall apply to shop or field welded moment connections. Welding methods, procedures and quality control shall comply with AWS D1.1-2010 and the following:
    1. Tack weld quality shall comply with AWS D1.1/D1.1M, Section 3.3.7.
    2. Arc strikes, gouges and other imperfections within or adjacent to the joint shall be repaired or removed.
    3. Preheat and interpass requirements shall be as outlined in AWS D1.1/D1.1M, Section 4.2.
    4. Use weld tabs and finish to a smooth contour, per AWS D1.1, Section 3.12.3.
    5. Backer bars shall be removed from the beam, bottom flange, connections to remove all slag and cracks. Weld the back-gouged region and finish welding using a reinforcing fillet weld, according to AWS D1.1/D1.1M, Section 3.13.4.
    6. Cracks, Gouges, grooves and notches will not be permitted in the joint area.
I. Oxygen cutting in the field shall be executed in accordance with the requirements under “Fabrication: Oxygen Cutting” in this section.
J. Templates shall be furnished for all anchor bolts. Furnish instructions for settling of anchors and bearing plates and ascertain that items are properly set during the progress of the work.
K. Anchor bolts set by others shall be verified for proper size and accurate location prior to erection of structural steel work.
L. Framing: As erection progresses, the work shall be securely connected to take care of all dead load, wind and erection stresses. Temporary bracing shall be introduced wherever necessary to take care of all loads to which the structure may be subjected, including erection equipment and its operation. Such bracing shall be left in place as long as may be required for safety. It shall finally be removed by the contractor as part of his equipment.
M. Fastening of splices of compression members shall be done after the abutting surfaces have been brought completely into contact. Bearing surfaces and surfaces that will be in permanent

contact shall be cleaned prior to final assembly of members.

N. Tolerances: All members shall be aligned, leveled and adjusted accurately prior to final fastening. Tolerances shall conform to the AISC "Code for Standard Practice."

O. All members shall be cut neat, true bevel or square and should be erected true and flush without twists and open joints. Light drifting to draw holes together will be permitted. Reference should be made to the code and specifications listed under General Requirements which shall govern all phases of fabrication, details, and erection and workmanship. Responsibility for all errors of fabrication and proper fitting of the various members shall be assumed by this contractor.

P. Framing and Bracing:
   1. All structural steel shall be erected true and plumb. Temporary shoring and bracing shall be used wherever necessary and shall be adequate for all loads to which the structure may be subjected, including wind and erection equipment and operation of same. Leave temporary bracing and shoring in place as long as may be required for safety, and until final framing construction is completed.
   2. No final connections shall be made until the structure has been properly aligned. All temporary flooring, planking and scaffolding necessary in connection with the erection of the structural steel, or the support of erection machinery shall be provided as part of the erection work. The temporary floors and scaffolding shall conform to the requirements of all laws governing safety regulations.
   3. Drifting done during assembly shall not distort the metal or enlarge the holes. Mismatching of holes greater than 3/32 inch shall require reaming for the next larger bolt. Mismatching of holes greater than 1/8" shall be cause for rejection.

Q. Defective Work:
   1. Work found to be defective, missing or damaged shall be immediately replaced with proper work. Such replaced work and the inspection for same shall be at the expense of the Contractor.
   2. Straightening of any material, if necessary, shall be done by a process and in a manner that will not injure the materials, and which is approved by the Architect/Engineer. Sharp kinks or bends shall be cause for rejection. Heating will not be allowed.
   3. Delamination and other rolling defects in structural shapes and plates shall be cause for rejection when, in the judgment of the Architect/Engineer repairs are not feasible or acceptable.
   4. If defects or damaged work cannot be corrected in the field, the material shall be returned to the shop or new parts furnished, as the Architect/Engineer directs; the Contractor shall replace all work at his own expense.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.04 TESTING AGENCY

A. Testing Agency - The Owner shall engage the services of an independent testing laboratory to perform the following services, the cost of which shall be paid by the Owner.

B. Prior to the fabrication and erection of any structural steel, a meeting shall be arranged by the Contractor for the Architect/Engineer, Steel Erector, and Testing Laboratory Inspector to review qualifications of welders, bolt tightening procedure, stud welding procedure, and procedures the Testing Laboratory Inspector(s) will follow.
   1. The installation and tightening of bolts shall be observed by the Testing Laboratory Inspector to determine that the selected bolt tightening procedure is properly followed and he shall test all field connections to determine that all bolts are tightened in accordance with the ASTM A325 Specifications.
   2. Welding inspection shall include one hundred percent (100%) testing by ultrasonic method of all beam to column full penetration welds. Welding inspection shall also include one hundred percent (100%) testing by ultrasonic method, or by other approved equivalent methods conforming to AWS D1.1, or all groove welds which are part of the seismic force resisting systems. The cost of retesting any defective welds shall be borne by the Contractor. A qualified welding inspector shall be employed to perform the duties as outlined in the AWS D1.1 Section 6, Inspection. Welding inspection shall also include

visual checking of all critical fillet welds.

3. The nondestructive testing rate for an individual welder may be reduced to 25 percent with the concurrence of the Structural Engineer of Record, provided that the rejection rate is demonstrated to be 5 percent or less of the welds tested for the welder.

C. Promptly furnish to the Architect/Engineer and Owner the reports of the Testing Laboratory on the above testing.

D. Testing Coordination - Cooperate with and facilitate inspection and testing by the testing agency. It is recommended that the steel erector contractor and steel fabricator contact the approved testing lab, of the Owner's choice prior to beginning any welding. A program of joint preparation and welding procedures should be worked out between the two parties before the welding is started so that correct welds will be made from the beginning. Furnish the testing agency, upon request with the following:

1. Complete sets of approved erection drawings, detailed shop drawings, schedules and corrective work procedures at the fabrication shop or shops and in the field.
2. Cutting list, order lists, material bills, and shopping lists.
3. Information as to time and place of all rollings and shipment of material to shops.
4. Assistance for testing materials and proper facilities for inspection of the work, in the mill, shop, and field.

3.05 TESTS AND INSPECTIONS

A. All structural steel materials shall be tested, and all welding and fabrication shall be inspected by the Owner’s testing laboratory. The Owner may test all welds by means of X-Ray, ultrasonic, or any other appropriate, non-destructive procedure. Additional testing required as a result of corrective measures to correct defects shall be paid by the Contractor. Testing shall comply with the requirements of AWS 7. A copy of all weld testing reports shall be provided to the structural engineer.

B. Structural Steel: Mill analysis and test reports certified and properly executed by the manufacturer will constitute sufficient evidence of conformity with the specifications. Contractor shall identify steel as to heat number and furnish the testing laboratory mill tests and manufacturer’s certification for each heat of steel. If the material cannot be identified or its source is questionable, one set of tension and bend tests shall be made by the testing laboratory for each 5 tons or fractional part thereof of each size.

1. The cost of all tests, including sampling and machining of test coupons, will be paid by the Owner.
2. The Contractor shall cooperate with testing engineers and provide all materials required to take coupons for testing.

C. Fabrication Inspection: All fabrication of structural steel shall be inspected by the fabricator. This inspection shall consist of, but shall not necessarily be limited to, the following:

1. Visually inspect steel shapes and plates for existence of defects, such as laminations and non-metallic inclusions. Use ultrasonic equipment to determine extent of defects.
2. Confirm that sections used conform to dimensional standards specified.
3. Ultrasonic testing of base plates, column flanges at beam and girder moment connections and bracing connections, and top and bottom flanges of beams at bracing connections shall be performed in accordance with ASTM A578-80. For column flanges, inspect an area extending 6” above and 6” below point where beam and/or girder flanges are attached. For column and beam flanges, inspect an area extending 6” beyond each end of bracing connections where attached to the flanges. Any recordable discontinuity causing complete loss of back reflection and which cannot be encompassed within a 3-inch diameter circle or one-half the plate thickness, whichever is larger, is unacceptable. Inspect connection areas on all beams and columns.

D. Welding Inspection: Welding shall be inspected by a qualified inspector employed by the testing laboratory. This inspector shall confirm the qualification of welders, the use of AWS qualified procedures, the manufacturer’s recommended use of automatic equipment, and the proper use of preheat, if required.

1. All complete penetration groove welds and partial penetration groove welds shall be subject to ultrasonic testing by qualified technician, who shall operate the equipment, examine the welds and maintain a record of all welds examined, defects found and

disposition of each defect. All defective welds shall be repaired by the Contractor and retested with ultrasonic equipment at the expense of the Contractor.

2. Initially, all welds requiring ultrasonic testing shall be tested at the rate of 100% in order to establish the qualifications of each individual welder.
3. When ultrasonic indications arising from the weld root can be interpreted as either a weld defect or the backing strip itself, the backing strip shall be removed at the expense of the Contractor, and if no root defect is visible, the weld shall be retested. If no defect is indicated on this retest, and no significant amount of the base and weld metal has been removed, no further repair of welding is necessary. If a defect is indicated, it shall be repaired by the Contractor and retested at the expense of the Contractor.
4. The ultrasonic instrumentation shall be calibrated by the technician to evaluate the quality of the welds in accordance with AWS D1.1.
5. Headed stud anchor (HSA's) welding and deformed bar anchor (DBA) welding shall conform to the manufacturer's specifications. Welding shall be tested to comply with AWS D1.1, Section 7.6 through 6.8 and Appendix K of the AISC Specifications.
6. Where runoff tabs are used, they shall be removed and the edges shall be ground smooth and shall be visually inspected in conformance with AWS D1.1, Subsection 8.15.

E. Erection Inspection: All erection of structural steel shall be inspected by the testing laboratory. Provisions under Fabrication and Welding Inspection shall apply.
1. All welding shall be inspected by the testing laboratory. Butt and complete penetration welds shall be ultrasonically tested as per provisions under Welding Inspection.
2. High strength bolting shall be inspected by the testing laboratory in conformance with the Specifications for Structural Joints using ASTM A325 and ASTM A490 bolts, as approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

F. Welded connections between the primary members of Intermediate and Special Moment Resisting Steel Frames (IMRSF) and (SMRSF) shall be tested for compliance according to SBC Section 1708.2 and these Contract Specifications and Plans. Inspection shall be done by a qualified testing inspector. As a minimum, the testing shall include the following:
1. All complete penetration groove welds contained in joints and splices shall be tested 100%, either by ultrasonic testing or by radiography.
2. Partial penetration groove welds, when used in column splices, shall be tested either by ultrasonic testing or radiography. A minimum of 50% of these welds shall be tested.
3. Any material discontinuities shall be accepted or rejected on the basis of the defect rating in accordance with the AWS Standards as they refer to the testing on AWS D1.1-84, Chapter 6, excluding Sections 6.1 through and including 6.6. All deficient welds shall be corrected and tested at no additional cost to the Owner.

G. Source Quality Control:
1. The Contractor shall maintain his own quality control and inspection of all shop work. Records of tests shall be readily available for examination by the Architect/Engineer or his designated representative and copies of which shall be turned over to the Architect/Engineer upon request.
2. Acceptance at the shop shall not prevent final rejection at the job site if work is found to be defective in any way.
3. Unless otherwise noted, when compliance with the referenced specifications, etc., or this specification is specified for materials or a manufactured or fabricated product, the Contractor, if requested, shall furnish the Architect/Engineer with an affidavit from the manufacturer or fabricator certifying that the material product delivered to the project meets the requirements of the Contract Documents.

DIVISION 05 21 00 – STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.
B. Loose bearing members, such as plates or angles, and anchor bolts for site placement.
C. Supplementary framing for floor and roof openings greater than 18 inches.

D. Furnishing of, and paying for all labor, materials, services, appliances, and equipment necessary for the execution, installation, and completion of all work specified herein.
E. The extent of the work is shown on the drawings, including basic layout and type of joists required. Unless otherwise specified, the following items are included:
   1. Steel joists, joist girders, joist extended ends, ceiling extensions, extended bottom chords used as struts, bridging and bridging anchors, joist girder bottom chord bracing, joist wall and beam anchors, headers (which are defined as a member supported by and carrying open-web steel joists), loose bearing plates, anchor bolts for site placement. Provide design for special loads or special joists noted on plans.

1.02 RELATED REQUIREMENTS

A. *Division 01 30 00* - Administrative Requirements
B. *Division 01 40 00* - Quality Requirements; testing laboratory services.
C. *Division 03 30 00* - Cast-in-Place Concrete: Placement of anchors for casting into concrete.
D. *Division 04 20 00* - Unit Masonry: Placement of anchors for embedding into masonry.
E. *Division 05 12 00* - Structural Steel Framing: Grouting base plates and bearing plates. Superstructure framing.
F. *Division 05 31 00* - Steel Decking: Bearing plates and angles.
G. *Division 05 50 00* - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2013.
C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
F. ASTM A449 - Standard Specification for Quenched and Tempered Steel Bolts and Studs.
G. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2007a (Reapproved 2014).
H. ASTM E94 - Standard Guide for Radiographic Examination; 2004 (Reapproved 2010).
I. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.
J. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2023.
K. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.
L. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
M. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.
N. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
O. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
P. ITS (DIR) - Directory of Listed Products; current edition.
Q. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.
R. SJI 100 - Standard Specifications for K-Series, LH-Series, and DLH-Series Open Web Steel Joists, and for Joist Girders; 2020.
S. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders; 2008.
T. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
U. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
V. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
W. SSPC-SP 3 - Power Tool Cleaning; 1982 (Ed. 2004).
X. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments. Shop drawings shall show joist type, size and spacing; layout in plan; and fabrication and erection details including methods of anchoring, framing at openings; and size and spacings of bridging including end anchorage details. Shop drawings shall also include calculations of design for any special joists marked "SP" for record only. No reproduction of Contract Drawings for use as shop drawings will be permitted.
C. Submit calculations and member shop drawings for all special joists indicated on plans. Indicate welded field connections using standard AWS welding symbols. Indicate net weld lengths.
D. Show type of paint and all accessories and details required for proper installation of joists.
E. Prepare shop drawings and calculations as required under seal of a licensed professional engineer registered in the State in which the project is located.
F. Review of shop drawings will be for type, size, and arrangement of principal and auxiliary components and strength of connections. Dimensional errors on shop drawings are the responsibility of the Contractor.
G. Submit manufacturer's specifications and installation instructions for each type of joist and accessory. Include manufacturer's certification that joists comply with SJI specifications.
H. Submit Certificates of qualification for all welders, if required.
I. Tests and Test Reports: The Contractor shall provide one of the following, at his option, at his expense, and at the time Shop Drawings are submitted:
    1. Certificate stating that joists are manufactured by a member of the Steel Joist Institute and conform to all requirements of the AISC Standard Specifications.
    2. Design computations, and results of Load Tests conducted by an independent testing laboratory establishing the following for the appropriate series joist designation:
        a. Design computations in conformance with joist-strength and specification requirements of the AISC Standard Load Tables and Standard Specifications.
        b. Results of Load tests in conformance with the performance test of the AISC. All testing shall be subject to approval.
J. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.
K. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
B. Perform Work, including that for headers and other supplementary framing, in accordance with SJI 100 Standard Specifications Load Tables and SJI Technical Digest No. 9.
C. Design and Installation Requirements: Comply with UL (FRD) Assembly Design.
D. Manufacturer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
E. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
F. Erector Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
G. Provide joists fabricated in compliance with the following, and as herein specified:
    1. Steel Joist Institute (SJI) Standard Specifications, Load Tables and Weight Tables for all K-series open-web steel joists and LH joists.
H. Qualify welding processes and welding operators in accordance with American Welding Society (AWS), "Standard Qualification Procedure."
I. Joists welded in place are subject to inspection and testing. Expense of removing and replacing any portion of steel joists for testing purposes will be borne by the Owner if welds are found to be satisfactory. Remove and replace work found to be defective and provide new acceptable work.
J. Obtain supplier-furnished written certification that his current design(s) has been checked by SJI and found to conform to the applicable SJI specifications and the recommended Code of Standard Practice for Steel Joists or design verification tests conforming to the requirements of

SJI Standard Specifications, Section 4.6 (H-series or K-series only).

K. The Owner reserves the right to have his representative make an inspection of the joists prior to shipment.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect products to SJI requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Joists:
   1. Canam Group Inc: www.canam-steeljoists.ws
   2. Nucor-Vulcraft Group: www.vulcraft.com/#sle.
   3. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 MATERIALS

A. Open Web Joists: SJI Type K Joists:
   1. Provide bottom chord extensions as indicated.
   2. Minimum End Bearing on Steel Supports: Comply with referenced SJI standard.
   3. Minimum End Bearing on Concrete or Masonry Supports: Comply with referenced SJI standard.
   4. Finish: Shop primed.

B. Open Web Joists: SJI 100 Type LH Joists:
   1. Provide bottom chord extensions as indicated.
   2. Minimum End Bearing on Steel Supports: Comply with referenced SJI standards.
   3. Minimum End Bearing on Masonry or Concrete Supports: Comply with referenced SJI standards.
   4. Finish: Shop primed.

C. Open Web Joists: SJI 100 Type DLH Joists:
   1. Provide bottom chord extensions as indicated.
   2. Minimum End Bearing on Steel Supports: Comply with referenced SJI standards.
   3. Minimum End Bearing on Masonry or Concrete Supports: Comply with referenced SJI standards.
   4. Finish: Shop primed.

D. Open Web Composite Joists: SJI 100 Type CJ Joists:
   1. Provide bottom chord extensions as indicated.
   2. Minimum End Bearing on Steel Supports: Comply with referenced SJI standards.
   3. Minimum End Bearing on Masonry or Concrete Supports: Comply with referenced SJI standards.
   4. Finish: Shop primed.

E. Anchor Bolts, Nuts and Washers: ASTM A307 hot-dip galvanized per ASTM A153/A153M Class C.

F. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.

G. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.

H. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36/A36M.

I. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

J. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

K. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

L. Open-web joist members must conform to SJI Standard Specifications, Section 3, "Materials" (round-rod bottom chord members are not permitted).

M. Applicable AWS D1.1, type(s) required for materials being welded. For open-web steel joists K-series must conform to SJI Technical Digest No. 8, Welding of Open-Web Steel Joists.

N. Anchor bolts and required nuts and washers must conform to ASTM A307 (A325).

O. Primer paints must conform to SJI Standard Specifications, Section 3.3, "Paint." Options are SSPC Specification 15-68T, Type I (red oxide), Federal Specification TT-P-636, "Alkyd, Wood, and Ferrous Metal," or a shop paint which meets the minimum performance requirements of one of the above.

2.03 FABRICATION

A. Design and fabricate steel joists in accordance with SJI Standard Specifications, including headers and other support framing. Verify drawing dimensions and field conditions prior to commencing fabrication. Provide for concentrated loads shown on structural drawings.
B. Provide bottom joist chord extensions at all columns not framed in at least two [2] directions with structural steel members and connect thereto or as otherwise shown on drawings.
C. Provide extended ends on joists where shown, complying with manufacturer's standards and requirements of applicable SJI specifications and load tables and designed loads shown onthe drawings.
D. Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord. Provide either an extended bottom chord element or a separate unit of sufficient strength to support ceiling construction to suit manufacturer's standards. Extend ends to within one-half [½"] inch of finished wall surface unless otherwise indicated.
E. Provide horizontal or diagonal type bridging for open-web joists, complying with SJI specifications and as noted on plans. Provide bridging anchors for ends of bridging lines terminating at walls or beams. Check standing seam roof deck systems where applicable and provide bridging as required to adequately brace top chords against lateral movement under full loading conditions. Check bridging design to accommodate uplift forces due to wind as noted on drawings.
F. Provide end anchorages to secure joists to adjacent construction, complying with SJI specifications unless otherwise indicated.
G. Provide header units to support tail joists at openings in floor or roof system not framed with steel shapes.
H. Camber joists to allow for dead-load deflection as provided in the SJI Standard Specifications.
I. Remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories before application of shop paint.
    1. Apply one [1] shop coat of primer paint to steel joists and accessories, by spray, dipping, or other method to provide a continuous dry paint film thickness of no less than 0.50 mil. Asphalt coating is not permitted where field painting is required.
J. Drill holes in chords for attachment of wood nailers where indicated.
K. Frame special sized openings in joist web framing as detailed.
L. Space stud shear connectors on top of top chords as indicated on drawings.
M. Tolerances:
    1. Overall Length tolerances are up to eighty [80'-0"] feet, maximum tolerance ± three-eighths [3/8"] inch and eighty [80'-0"] feet and over, maximum tolerance ± one-half [½"] inch.
    2. Maximum depth tolerance minus one-quarter [-¼"] inch, plus one-half [+1/2"] inch measured at the panel point on the vertical axis of the joist.
    3. Bearing Ends:
        a. Depth: maximum tolerance ± one-eighth [1/8"] inch on manufacturer's specified depth.
        b. Bearing surface squareness: maximum tolerance of ± three-eighths [3/8"] inch per foot in transverse and longitudinal directions.
    4. Cross-Section Deviation:
        a. Three-sixteenths [3/16"] inch maximum vertical displacement between thetwo members of a two-member top chord.
        b. One-quarter [¼"] inch maximum vertical displacement between the two members of a two-member bottom chord.
    5. Slotted Bearing Connections:
        a. Maximum tolerance of ± three-eighths [3/8"] inch C.C. of slots along length ofjoist.
        b. Maximum tolerance of ± one-eighth [1/8"] inch C.C. of slots along gauge line.
            1) Maximum camber tolerance on manufacturer's specified camber must be ± one-quarter [¼"] inch or ± length (in inches)/1600, whichever is greater. No negative camber is allowed, and no consideration is made for joist weight deflection.
            2) Lateral Sweep shop tolerance must not exceed one-half [½"] inch or length (in inches)/360, whichever is greater. Verification of shop tolerance must be made prior to erection. Measurement must be made by supporting the joist by its top chord at the approximate one-third [1/3] points and letting it hang freely. The

lateral displacement of the top chord from a straight line connecting the joist ends will constitute the amount of lateral sweep.

2.04 FINISH

A. Galvanize joists as specified.
   1. Do not prime surfaces that will be fireproofed.
   2. Galvanize steel ledge angles.
   3. Leave other steel members unprimed.
B. Prepare surfaces to be finished in accordance with SSPC-SP 2.
C. Galvanizing: Provide minimum 1.7 oz/sq ft galvanized coating to ASTM A123/A123M requirements.

2.05 SOURCE QUALITY CONTROL

A. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts", testing at least percent of bolts at each connection.
B. Welded Connections: Visually inspect all shop-welded connections and test at least 10 percent of welds using one of the following:
   1. Radiographic testing performed in accordance with ASTM E94.
   2. Ultrasonic testing performed in accordance with ASTM E164.
   3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
   4. Magnetic particle inspection performed in accordance with ASTM E709.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 ERECTION

A. Handle, place, and secure steel joists in accordance with SJI Standard Specifications and approved shop drawings. Protect joists and accessories from harmful elements and store above ground on platforms, pallets, or other supports. Keep joists free of dirt and other foreign matter.
B. Furnish anchor bolts and other devices to be built into concrete and masonry construction:
   1. Furnish unfinished threaded fasteners for anchor bolts, unless otherwise indicated.
   2. Refer to DIVISION 3 sections of this Project Manual for installation of anchors set in concrete.
   3. Refer to DIVISION 4 sections of this Project Manual for installation of anchors set in masonry.
C. Do not start placement of steel joists until supporting work is in place and secured. Place joists on supporting work, adjust and align in accurate locations and spacing before permanently fastening.
   1. Provide temporary bridging, connections, and anchors to ensure lateral stability during construction.
   2. Where open-web joist lengths are forty [40'-0"] feet and longer, install a center row of bolted bridging to provide lateral stability before slackening of hoisting lines.
D. Install bridging simultaneously with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where they terminate at walls or beams.
E. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.
F. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.
G. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.
H. Position and field weld joist chord extensions and wall attachments as detailed.
I. Install supplementary framing for floor and roof openings greater than 18 inches.
J. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
K. Do not field cut or alter structural members without approval of joist manufacturer.
L. Fastening Joists:
   1. Field weld joists to supporting steel framework in accordance with SJI specifications for type of joists used as noted on plans. Coordinate welding sequence and procedure with placing of joists.

2. Secure joists resting on masonry or concrete bearing surfaces by bedding in mortar and anchoring to masonry or concrete construction as specified in SJI specifications for type of steel joist used.
3. Provide unfinished threaded fasteners for bolted connections, unless otherwise indicated.
4. Provide unfinished threaded fasteners for bolted connections except where high-strength bolts or welded connections are required and shown on shop drawings.
5. Provide high-strength threaded fasteners for bolted connections of steel joists to steel columns, and at other locations as shown, installed in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.

M. Obtain review and approval by the Architect/Engineer prior to field-cutting or altering of joists or bridging.
N. Repair or replace all damaged joists as approved by the Architect/Engineer.
O. Attachments to joists must be made in such a manner, or at such locations, that local bending is not introduced into the joist chords.
P. After erection, prime welds, damaged shop primer, damaged galvanizing, and surfaces not shop primed, except surfaces specified not to be primed.
Q. Grouting: Grout per manufacturer's instructions for joist installation in concrete and masonry construction.
R. Touch-Up Painting:
1. After joist installation, paint field bolt heads and nuts, welded areas, and/or abraded or rusty surfaces on joists and steel supporting members under Section 09 9000. Wire brush surfaces and clean with solvent before painting. Use same type of paint as used for shop painting.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.
B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts", testing at least percent of bolts at each connection.
C. Welded Connections: Visually inspect all field-welded connections and test at least 10 percent of welds using one of the following:
1. Radiographic testing performed in accordance with ASTM E94.
2. Ultrasonic testing performed in accordance with ASTM E164.
3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
4. Magnetic particle inspection performed in accordance with ASTM E709.

DIVISION 05 31 00 – STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof deck.
B. Composite roof deck, to comply with FEMA 361-08 requirements.
C. Metal form deck.
D. Supplementary framing for openings up to and including 18 inches.
E. Bearing plates and angles.
F. Stud shear connectors.

1.02 RELATED REQUIREMENTS

A. *Division 03 20 00* - Concrete Reinforcing.
B. *Division 03 30 00* - Cast-in-Place Concrete: Concrete topping over metal deck.
C. *Division 05 12 00* - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.
D. *Division 05 12 00* - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.
E. *Division 05 21 00* - Steel Joist Framing: Support framing for openings larger than 18 inches and

shear stud connectors.

F. *Division 05 50 00* - Metal Fabrications: Steel angle concrete stops at deck edges.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittals procedures.

B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

1. Other Decks:

a. Deck layout and orientation, supporting steel framing and supports with dimensions and section details.

b. Deck type and profile, dimensions, supports, projections, openings and reinforcements.

c. Welds and mechanical fastener types, sizes and patterns.

d. Side lap connector types, sizes and patterns.

e. Accessory details.

D. Certificates: Certify that products furnished meet or exceed specified requirements.

E. Submit manufacturer's installation instructions.

F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.04 QUALITY ASSURANCE

A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

C. Installer Qualifications: Company specializing in performing the work of this Section with minimum five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Cut plastic wrap to encourage ventilation.

B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Deck:

1. Canam Steel Corporation: www.canam-steeljoists.ws.
2. Cordeck, Inc: www.cordeck.com.
3. Nucor-Verco Decking Inc.; Formlok.
4. Substitutions: See *Division 01 25 00*

2.02 STEEL DECK

A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.

1. Calculate to structural working stress design and structural properties specified.
2. Maximum Vertical Deflection of Floor Deck: 1/360 of span.
3. Maximum Vertical Deflection of Roof Deck: 1/240 of span.
4. Maximum Vertical Deflection of Form Deck: 1/360 of span.
5. Maximum Lateral Deflection of Diaphragms: 1/500 of the height of the wall.

B. Roof Deck: Non-composite type, fluted steel sheet:

1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.

a. Grade as required to meet performance criteria.

2. Ungalvanized Steel Sheet: ASTM A1008/A1008M, Designation SS, Grade 33, Type 1.

a. Grade as required to meet performance criteria.

3. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.

4. Structural Properties:
    a. Section modulus: as indicated on the drawings.
    b. Span Design: Double.
5. Minimum Base Metal Thickness: As indicated on the drawings.
6. Nominal Height: 1-1/2 inch.
7. Profile: Fluted; SDI NR.
8. Formed Sheet Width: as indicated on the drawings.

C. Metal Form Deck: Corrugated sheet steel, with provision for ventilation of concrete:
1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
    a. Grade as required to meet performance criteria.
2. Ungalvanized Steel Sheet: ASTM A1008/A1008M, Designation SS, Grade 33, Type 1.
    a. Grade as required to meet performance criteria.
3. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
4. Properties, size, gage, and width as indicated on the drawings.

D. Acoustical Roof Deck
1. Provide information as appropriate.

2.03 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A36/A36M steel unfinished.
B. Stud Shear Connectors: Made from ASTM A108 Grade 1015 bars.
C. Welding Materials: AWS D1.1/D1.1M.
D. Fasteners: Galvanized hardened steel, self tapping.
E. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.
F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
H. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

2.04 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gauge, 0.0299-inch-thick sheet steel; of profile and size as indicated; finished same as deck.
B. Cant Strips: Formed sheet steel, 22 gage minimum thickness, 45-degree slope, 3-1/2-inch nominal width and height, flange for attachment.
C. Roof Sump Pans: Formed sheet steel, 14-gauge, 0.0747-inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.
D. Floor Drain Pans: Formed sheet steel, 14-gauge, 0.0747-inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below floor deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
B. On concrete and masonry surfaces provide minimum 4-inch bearing.
C. On steel supports provide minimum 1-1/2-inch bearing.
D. Fasten deck to steel support members at ends and intermediate supports as indicated on the drawings, parallel with the deck flute and at each transverse flute using methods specified.
1. Welding: Use fusion welds through weld washers.
2. Place and secure special deep fluted sections for integral concrete bridging.

E. Drive mechanical side lap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.
F. Weld deck in accordance with AWS D1.3/D1.3M.
G. At deck openings from 6 inches to 18 inches in size, provide 2 by 2 by 1/4-inch steel angle

reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.

H. Where deck (other than cellular deck electrical raceway) changes direction, install 6-inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.

I. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.

J. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.

K. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

L. Place metal cant strips in position and fusion weld.

M. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

N. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

O. Weld stud shear connectors through steel deck to structural members below.

P. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

DIVISION 05 40 00 – COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed steel stud exterior wall and interior wall framing.

B. Exterior wall sheathing.

C. Formed steel joist, miscellaneous, purlin, miscellaneous, slotted channel, miscellaneous, and miscellaneous framing and bridging.

1.02 RELATED REQUIREMENTS

A. *Division 04 30 00* - Exterior Stone Cladding: Stone veneer supported by wall stud metal framing.

B. *Division 05 31 00* - Steel Decking.

C. *Division 05 40 00* - Cold-Formed Metal Trusses.

D. *Division 06 10 00* - Rough Carpentry: Wood blocking and miscellaneous framing.

E. *Division 06 10 00* - Rough Carpentry: Roof and wall sheathing.

F. *Division 07 21 00* - Thermal Insulation: Insulation within framing members.

G. *Division 07 62 00* - Sheet Metal Flashing and Trim: Head and sill flashings.

H. *Division 07 92 00* - Joint Sealants.

I. *Division 09 21 16* - Gypsum Board Assemblies: Lightweight, non-load bearing metal stud framing.

J. *Division 09 21 16* - Gypsum Board Assemblies: Gypsum-based sheathing.

K. *Division 09 21 16* - Non-Structural Metal Framing.

L. *Division 09 51 00* - Acoustical Ceilings: Ceiling suspension system.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.

C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened and Bake Hardenable; 2016.

D. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.

E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.

F. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.

G. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing; 2014a.
H. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
I. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc.; 2013.
J. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
K. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that are to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, and limitations.
C. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
    1. Component details, framing openings, bearing, anchorage, loading, temporary bracing, types and locations of mechanical fasteners, finish and accessories and items required of other work for complete installations shall be indicated.
    2. Framing layouts shall be detailed.
    3. Describe method for securing studs to tracks and for bolted framing connections.
    4. Provide design Architect/Engineer's stamp on shop drawings.
    5. Calculations for loadings and stresses of specially fabricated framing, signed and sealed by a professional structural engineer.
    6. Details and calculations for factory-made framing connectors, signed and sealed by a professional structural engineer.
E. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect metal framing units from rust and damage. Deliver to the job site in manufacturer’s unopened containers or bundles, fully identified with name, brand, type, and grade. Store off ground in a dry, well-ventilated space or protect with suitable waterproof coverings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing:
    1. CEMCO: www.cemcosteel.com.
    2. ClarkDietrich Building Systems: www.clarkdietrich.com.
    3. Marino: www.marinoware.com.
    4. SCAFCO Corporation: www.scafco.com/#sle.
    5. Steel Construction Systems: www.steelconsystems.com/#sle.
    6. The Steel Network, Inc: www.SteelNetwork.com.
    7. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Framing Connectors and Accessories:
    1. Same manufacturer as metal framing.
    2. Simpson Strong Tie: www.strongtie.com.
    3. Substitutions: *01 25 00* - Substitution Procedures.

2.02 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
B. Design Requirements: Provide completed framing system having the following characteristics:
    1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100-12.
    2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified

design loads for project conditions within required limits.
3. Design Loads: In accordance with applicable codes and as indicated on the drawings.
4. Live load deflection meeting the following, unless otherwise indicated:
    a. Floors: Maximum vertical deflection under live load of 1/360 of span.
    b. Roofs: Maximum vertical deflection under live load of 1/240 of span.
    c. Exterior Walls: Maximum horizontal deflection under wind load of 1/180 of span. 1/360 where exterior tile or thin veneer masonry is indicated.
    d. Design non-axial loadbearing framing to accommodate not less than 1/2 in vertical deflection.
5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

C. Shop fabricate framing systems to the greatest extent possible.
D. Deliver to project site in largest practical sections.

2.03 FRAMING MATERIALS

A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.
1. Gauge and Depth: As required to meet specified performance levels.
2. Gauge and Depth: As scheduled.
3. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
4. Provide components fabricated from ASTM A1008/A1008M Designation SS (structural steel).

B. Joists and Purlins: Fabricated from ASTM A653/A653M steel sheet, with G90/Z275 hot dipped galvanized coating.
1. Base Metal: Structural Steel (SS), Grade 33/230.
2. Base Metal: As required to meet specified performance levels within maximum depths indicated.
3. Gauge and Depth: As required to meet specified performance levels.
4. Gauge and Depth: As scheduled.

C. Framing Connectors: Factory-made, formed steel sheet.
1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10-gauge, 0.1345 inch, and factory punched holes and slots.
2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
    a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
    b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
    c. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 10 feet.
    d. Provide top track with long leg track and head of wall movement connectors; minimum track length of 10 feet.
4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
5. Wall Stud Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connections where indicated on the drawings.

2.04 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
   1. Products:
      a. ITW Commercial Construction North America; ITW CCNA-Buildex Teks Select Series: www.ITWBuildex.com/#sle.
      b. Hilti, Inc.
      c. Simpson Strong Tie Company, Inc.
      d. Substitutions: See *01 60 00* - Product Requirements.

B. Anchorage Devices: Powder actuated.

C. Welding: Comply with AWS D1.1/D1.1M.

2.05 WALL SHEATHING

A. Wall Sheathing: As indicated on the drawings.

2.06 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

B. Plates, Gussets, Clips: Formed Sheet Steel, thickness determined for conditions encountered; finish to match framing components.

C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION OF STUDS

A. Install components in accordance with ASTM C1007 requirements and ASTM C1007 requirements.

B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.

C. Place studs at 16 inches on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.

D. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.

E. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.

F. Install load-bearing studs, brace, and reinforce to develop full strength and achieve design requirements.

G. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

H. Install intermediate studs above and below openings to align with wall stud spacing.

I. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.

J. Attach cross studs to studs for attachment of fixtures anchored to walls.

K. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

L. Touch-up field welds and damaged galvanized surfaces with primer.

3.03 INSTALLATION OF JOISTS AND PURLINS

A. Install framing components in accordance with manufacturer's instructions.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.

C. Place joists at 16 inches on center; not more than 2 inches from abutting walls, and connect joists to supports using fastener method.

D. Set ceiling joists parallel and level, with lateral bracing and bridging.

E. Utilize thermally broken clips, fiberglass girts, or similar accessories where ceiling joists attach to vertical walls to avoid thermal bridging between exterior ceiling joists and exterior wall surface. Fill all voids with continuous insulation.

F. Provide web stiffeners at reaction points.

G. Touch-up field welds and damaged galvanized surfaces with primer.

3.04 INSTALLATION OF WALL SHEATHING

A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
   1. Provide steel diagonal bracing at corners with foam insulation or gypsum board wall sheathing.

3.05 TOLERANCES

A. Maximum Variation from True Position: 1/8 inch.
B. Maximum Variation of any Member from Plane: 1/8 inch.

3.06 FABRICATION

A. Where shop fabricated assemblies are required, manufacturers/fabricators shall fabricate assemblies of sizes and profiles required, with joints fitted and secured, reinforced and braced to meet project requirements. Assemblies shall be fitted and assembled in largest practical sections for delivery to the project for installation.
   1. Fabricate trusses plumb, square, true to line and braced against racking, with joints screwed.
   2. Perform lifting of trusses in a manner to prevent damage or distortion.
B. Fastenings: Attach similar components by screw fasteners.
   1. Attach dissimilar components by bolting or screw fasteners as standard with manufacturer.
   2. Truss anchors shall be anchored to steel supports or cast in place for reinforced masonry walls and concrete substrates. The design and supply of the embeds for masonry and concrete substrates shall be by the truss manufacturer. Placement shall be in accordance with the truss manufacturer's shop drawings.
C. All abrasions to members from cutting shall be touched up with the specified primer.

3.07 ERECTION

A. Head and sill tracks shall be aligned as shown on drawings and secured into place with the specified fasteners at a maximum of 16" on center and no nearer than 4" from either end of the track.
B. Studs shall be placed at centers shown on plans, and not more than 2" from abutting walls and at each side of all openings. Studs must be connected to tracks using screws, in accordance with the approved shop drawings.
C. Corners shall be constructed using a minimum of three (3) studs. Provide for double studs at exhaust fan opening and other framed openings. Intermediate studs shall be installed above and below openings to match wall stud spacing.
D. Framing between studs for attachment of electrical boxes and other mechanical and electrical items must be installed.
E. Load bearing studs shall be erected in one piece, full length. Splicing and wire tying of framing components will not be permitted. Splices in the top or bottom chord of the truss members will not be permitted.
F. Erect the wall studs and brace and reinforce to meet design requirements. Studs shall be seated squarely in track with stud flanges abutting track flanges. Studs shall be plumbed, aligned, and squarely attached to flanges of top and bottom on both sides of tracks and securely attached to clip angles at intermediate slab edges where stud bypasses slab construction.
G. Frame both sides of expansion and control joints, with separate studs; do not bridge the joint with components of the stud system.
H. Joists and rafters shall be located directly over bearing studs or a load distribution member shall be provided at the top track.
I. Provide web stiffeners at reaction points as shown on drawings.
J. Joist and rafter bridging shall be as shown on drawings.
K. End blocking shall be provided where joist/rafter ends are not otherwise restrained from rotation.
L. Provisions shall be made for erection stresses. Provide temporary alignment and bracing.
M. Provide deflection allowance below supported horizontal building framing in ceiling and head track for non-load-bearing framing in a method recommended by the manufacturer.
N. Framing must provide true and flat surfaces, ready to receive finishes.

3.08 CLEAN AND TOUCH-UP

A. Clean bolted connections and abraded areas and apply cold galvanizing compound to comply with ASTM A 780, except that the paint shall be brushed on or spray applied in multiple coats until a dry film thickness of 8 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide color blend with the surrounding galvanizing where galvanized items are not painted.

DIVISION 05 50 00 – METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel and aluminum items.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.
B. *Division 03 30 00* - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
C. *Division 05 51 00* - Metal Stairs.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.
H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
I. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use; 2010.
J. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
K. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2007a (Reapproved 2014).
L. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
M. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.
N. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
O. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019.
P. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
Q. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
R. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2018, with Editorial Revision.
S. ASTM B177/B177M - Standard Guide for Engineering Chromium Electroplating; 2011 (Reapproved 2021).
T. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

U. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.
V. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
W. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
X. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
Y. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
Z. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
AA. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
BB. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
CC. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
DD. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
    1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
    2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
        a. Include the following, as applicable:
            1) Design criteria.
            2) Engineering analysis depicting stresses and deflections.
            3) Member sizes and gauges.
            4) Details of connections.
            5) Support reactions.
            6) Bracing requirements.
C. Product Data: Provide data on specified products, including paints, describing physical and performance characteristics.
D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.
F. Product Data and Samples shall be submitted in accordance with *Division 01 30 00*.
G. Field measurements and proper material installation shall be verified by the Contractor.

1.05 QUALITY ASSURANCE

A. Design shall conform under the direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located. Submit signed and sealed calculations and shop drawings for review and approval.
B. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.
B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
C. Plates: ASTM A283/A283M.
D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
E. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
F. Slotted Channel Fittings: ASTM A1011/A1011M.
G. Anchors and Bolts: ASTM A307, ASTM A449, ASTM A563, and ASTM F436/F436M, as applicable. Bolts and studs, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A153/A153M.

H. Fasteners and Accessories: Furnish anchors and fasteners, washers, straps, and accessories as required for a complete and finished installation. Fasteners shall be stainless steel or galvanized steel as appropriate and approved for the location.
I. Concrete and Masonry Anchors: Where anchors are not cast into the concrete or masonry construction, provide hot-dip galvanized expansion type anchors with matching hot-dip galvanized steel bolts or studs with nuts, of sizes as indicated or required. Provide washers under all bolt heads and nuts.
J. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
K. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
L. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
M. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
N. Structural and miscellaneous steel not otherwise specified, shall conform to the Standard Specifications of the ASTM A36/A36M, latest edition.
O. Galvanized steel pipe shall conform to the requirements of Federal Specifications WW-P-406, Type I, Class A, zinc-coated.
P. Steel sheets and strips shall conform to the requirements of Federal Specifications QQ-S-636.
Q. Cast bronze shall conform to the requirements of Federal Specifications QQ-C-501.
R. All ferrous metals, except surface encased in concrete, shall be given one (1) shop coat, and all scratched, abraded or re-worked surfaces shall, before final painting, receive a coat of rust-inhibitive paint which meets the performance requirements of red lead mixed pigment, alkyd varnish, linseed oil paint FS TT-P-86, Type II; or red lead iron oxide, raw linseed oil, alkyd paint, Steel Structures Painting Council (SSPC) Paint 2-64; or basic lead silicon chromate base iron oxide, linseed oil, alkyd paint, FS TT-P-615, Type II.
S. Stainless steel: ASTM A276, type 316.

2.02 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.
F. Aluminum-Alloy Die Castings: ASTM B85/B85M.
G. Bolts, Nuts, and Washers: Stainless steel.
H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Continuously seal joined members by intermittent welds and plastic filler.
D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

A. Bollards: Refer to Drawings for exterior bollards.
B. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking and masonry; prime paint finish.
C. Lintels: As detailed; prime paint finish.
D. Door Frames for Overhead Door Openings and Wall Openings: Channel or tube sections; prime paint finish.
E. Recessed Mat Frames: As detailed; steel, galvanized finish.
F. Embeds: As detailed; steel, galvanized finish at exterior.
G. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.

H. Elevator Sill support: angle sections, prime paint finish.
I. Toilet Partition Suspension Members: Steel angle or Steel channel sections; prime paint finish.
J. Metal screens and panels: Aluminum or steel sheet with perforated pattern indicated. 14-gauge minimum thickness. U-edging 1-inch wide at all edges. Brush finish sheets and edging. Attach to framing with stainless steel fasteners. Separate dissimilar metals with coating or sheet gaskets.
K. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.

2.05 FINISHES - STEEL

A. Prime paint steel items.
   1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.
   2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
B. Prepare surfaces to be primed in accordance with SSPC-SP2.
C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
D. Prime Painting: One coat.
E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.
G. Chrome Plating: ASTM B177/B177M, nickel-chromium alloy, satin finish.

2.06 FINISHES - ALUMINUM

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick. Brush finish where indicated.
B. Superior Performance Organic Coating System: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system; color as indicated.
C. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.07 FABRICATION TOLERANCES

A. Squareness: 1/8-inch maximum difference in diagonal measurements.
B. Maximum Offset Between Faces: 1/16 inch.
C. Maximum Misalignment of Adjacent Members: 1/16 inch.
D. Maximum Bow: 1/8 inch in 48 inches.
E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work. Examine the areas and conditions under which miscellaneous metal items are to be installed, and correct conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.
B. After fabrication, all members shall be given a shop coat of rust inhibitive primer.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.
B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Field weld components as indicated on drawings and shop drawings.
D. Perform field welding in accordance with AWS D1.1/D1.1M.
E. Obtain approval prior to site cutting or making adjustments not scheduled.
F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
G. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction including threaded

fasteners for concrete inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

H. Cutting Fitting and Placement:
   1. Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications.
   2. Set work accurately in location, alignment and elevation, and make plumb level, true, and free from the rack measured from established lines and levels.
   3. Provide temporary bracing and anchors in formwork for items which are to be built into concrete or similar construction.
   4. Fit exposed connections accurately together to form tight hairline joints.
   5. Weld connections which are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
   6. Grind exposed joints smooth, and touch up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrications and are intended for bolted or screwed field connections.

I. Field welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of weld made, and methods in correcting welding work.

J. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide minimum dry field thickness of 2.0 mils.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

3.05 GALVANIZING REPAIR

A. Galvanized surfaces which have become damaged from welding, handling, or installation shall be repaired immediately after installation with galvanizing repair material in accordance with ASTM A780/A780M.

DIVISION 05 51 00 – METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stairs with concrete treads.

B. Structural steel stair framing and supports.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.

B. *Division 03 30 00* - Cast-in-Place Concrete: Concrete fill in stair pans; mesh reinforcement for landings.

C. *Division 03 30 00* - Cast-in-Place Concrete: Placement of metal anchors in concrete.

D. *Division 04 20 00* - Unit Masonry: Placement of metal fabrications in masonry.

E. *Division 05 52 13* - Pipe and Tube Railings: Metal handrails for the stairs specified in this section.

1.03 REFERENCE STANDARDS

A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2014.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.

H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
I. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
J. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
K. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.
L. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.
M. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
O. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
P. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
Q. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
R. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
S. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, including adhesives and paints, describing physical and performance characteristics.
C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
    1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
    2. Include the design engineer's seal and signature on each sheet of shop drawings.
    3. Comply with the pertinent provisions of Section 05 1200.
    4. Completely and accurately depict the spiral stairs, including but not necessarily limited to:
        a. Treads and risers ratio (2R + 1T > 24< 25).
        b. Connections to the building structure.
D. Delegated Design Data: As required by authorities having jurisdiction.
E. Design Data, Seismic Performance: Submit documentation that stairs meet performance requirements specified.
F. Welders' Certificates.
G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.
H. Design Responsibility
    1. The drawings indicate the basic components and dimensional requirements of the steel stairs.
    2. Within the parameters indicated on the Drawings and herein specified, the Contractor shall be responsible for the structural design of the steel stairs, including but not necessarily limited to, stringers, landings and all supports for the landings and required connections, both internal and those at the building structure.
    3. The stair structure and connections shall be designed to withstand the forces induced by the following loads:
        a. Live load: One hundred (100) pounds per square foot.
        b. Dead load: The weight of the stair structure plus the railings, the concrete fill and any special floor covering.
        c. Connections: Actual concentrated loads induced by the live load plus the dead load.
        d. Maximum deflection: 1/360 of the span in inches

e. Safety Factor: 1.65

1.05 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.

C. Fabricator Qualifications:
1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
2. A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
3. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
4. Comply with the pertinent provisions of *Division 05 12 00*.

D. Testing Laboratory Services:
1. Comply with the pertinent provisions of *Division 01 40 00*.
2. Comply with the pertinent provisions of *Division 05 12 00*.

1.06 PRECONSTRUCTION CONFERENCE

A. Comply with the pertinent provisions of *Division 05 21 00*.

B. Arrange for a preconstruction conference to be held at the Site of the Work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Custom Metal Stair Fabricators

B. Subject to the requirements herein specified and the pertinent provisions of Section 01 3000, products as produced by other nationally recognized manufacturers will be considered for use in the Work.

2.02 METAL STAIRS - GENERAL

A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
2. Handrails: Comply with applicable accessibility requirements of ADA Standards.
3. Structural Design: Provide complete stair and railing assemblies that comply with the applicable local code.
   a. Stair Capacity: Uniform live load of 100 lb/sq ft and a concentrated load of 300 lb with deflection of stringer or landing framing not to exceed 1/360 of span.
   b. Seismic Performance: Stairs designed to withstand the effects of earthquake motions determined according to ASCE 7.
      1) Component Importance Factor: 1.5.
      2) No permanent inelastic deformation occurs under movements equal to 2.5 percent inter-storey drift, minimum.
4. Dimensions: As indicated on drawings.
5. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
6. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
7. Separate dissimilar metals using paint or permanent tape.

B. Metal Jointing and Finish Quality Levels:
1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
   a. Welded Joints: Continuously welded and ground smooth and flush.
   b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
   c. Exposed Edges and Corners: Eased to small uniform radius.
   d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.

C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.03 METAL STAIRS WITH CONCRETE TREADS

A. Jointing and Finish Quality Level: Architectural, as defined above.
B. Risers: Closed.
C. Treads: Metal pan with field-installed concrete fill for egress stairs and precast concrete tread at monumental stairs.
   1. Concrete Depth: 1-1/2 inches, minimum.
   2. Tread Pan Material: Steel sheet.
   3. Tread Pan Thickness: As required by design; 14-gauge, 0.075 inch minimum.
   4. Factory Fabricated Tread and Nosing: Manufacturer's standard, field applied aluminum walking surface with integral nosing, abrasive filler and factory applied finishes.
   5. Pan Anchorage to Stringers: Continuously welded, from top or bottom.
   6. Pan Anchorage to Carriage Supports: shaped plate, angle, or tube support as determined by stair manufacturer.
   7. Concrete Reinforcement: Welded wire mesh.
   8. Concrete Finish: For sealed concrete floor finish at typical stairs and selected resilient floor covering (if any).
D. Risers: Same material and thickness as tread pans.
   1. Riser/Nosing Profile:
      a. Typical; Sloped riser with rounded nosing of minimum radius.
      b. Media Lounge: Flat riser with flush top edge
   2. Nosing Depth: 1-1/2 inch
      a. Typical: Not more than 1 inch overhang.
      b. Media Lounge: None.
   3. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.
      a. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.
E. Stringers: Rolled steel channels at typical egress stairs, tubes as indicated on drawings.
   1. Stringer Depth: 12" unless otherwise indicated on drawings or required by stair design engineer.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.
F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.
G. Finish: Shop- or factory-prime painted.
H. Under Side of Stair: Exposed to view, to be finished same as specified for other exposed to view surfaces.

2.04 HANDRAILS AND GUARDS

A. Wall-Mounted Rails: See *Division 05 52 13*.
B. Guards: Pipe railings, see *Division 05 52 13*.

2.05 *MATERIALS*

A. Steel Sections: ASTM A36/A36M.
B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
C. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.
D. Pipe: ASTM A53/A53M Grade B Schedule 40, black finish.
E. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
   1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
   2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
F. Concrete Fill: See *Division 03 30 00*.
G. Concrete Reinforcement: Mesh type as detailed, galvanized.

2.06 ACCESSORIES

A. Steel Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
B. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM

A153/A153M where connecting galvanized components.

C. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

D. Shop and Touch-Up Primer: SSPC-Paint 15, and comply with VOC limitations of authorities having jurisdiction.

1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, and comply with VOC limitations of authorities having jurisdiction.

2.07 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime Painting: Use specified shop- and touch-up primer.

1. Preparation of Steel: In accordance with SSPC-SP 2 Hand Tool Cleaning.
2. Number of Coats: One.

2.08 FABRICATION

A. Stringers:

1. The stringers shall be tub channel-shaped, fabricated from standard rolled components or may be cold-formed using the plate material herein specified.
2. The depth of the stringer shall be not less than 12 inches with a top flange wide enough to receive the handrail or guardrail posts and associated weld without overlapping.

B. Treads and Risers:

1. Cold form the treads and risers using the material herein specified, to the shapes and proportions indicated on the Drawings.
2. Provide all concrete treads with anti-slip surfacing.

C. Tolerances:

1. For an individual step:
   a. Riser: ±1/32 of an inch.
   b. Tread: A tread may be 1/16 of an inch greater than the dimension indicated on the Drawings; but in no case shall the tread be less than the indicated dimension.
2. For a flight of stairs:
   a. Rise: ±1/16 of an inch.
   b. Run: The run may exceed the dimension indicated on the Drawings 1/16 of an inch multiplied by the quantity of treads within the run; but in no case shall the run of the stair be less than the indicated dimension.

D. Assembly and Connections:

1. Assemble and connect in a manner that will provide strength and stability and ensure durability.
2. Stringers:
   a. The stringers shall be continuous members that span from landing to landing.
   b. Connections required at the intermediate landings shall be welded in a manner that will provide a hairline fit at the contacting surfaces.
   c. Maintain a continuity of line and accurate alignment of surfaces and angles where the stringers change from the bevel of the flight to the horizontal of the landings.
3. Treads and Risers:
   a. The treads and risers shall be connected to the stringers by one of the following methods:
      1) Sub-angles: Sub-angles welded to the stringers may be used to receive the treads and risers. These angles shall be not less than 1½ inches x 1½ inches x 1/8 of an inch thick and their length shall be equal to the riser height and the tread width and shall follow their profile. The treads and risers may be connected to these angles by either welding or bolting.
      2) Direct welding: The treads and risers may be welded directly to the stringers provided that the thickness of the plate used in their fabrication is not less than 1/16 of an inch.
4. All welds exposed to view shall be ground and dressed smooth.

E. Priming:

1. Clean all components of the steel stairs in accordance with SSPC-SP3, Power Tool Cleaning.

2. Apply one (1) coat of the rust-inhibitive primer normally used by the fabricator.
3. Apply the primer using a method that will result in an even, thorough cover, worked into all corners, bends and crevices and at a rate that will result in a DFT of not less than two (2) mils.
4. Do not apply primer to surfaces that are to be welded during erection.
5. Remove any primer inadvertently applied to these surfaces prior to welding.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.
B. Verify the field measurements are as indicated on Shop Drawings.
C. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

A. When field welding is required, clean and strip primed steel items to bare metal.
B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.03 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.
B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.
C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
F. Obtain approval prior to site cutting or creating adjustments not scheduled.
G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.
H. Connections:
    1. Connections to the building structure shall be accomplished by either welding or bolting.
    2. All field bolted connections shall be bearing-type, using the high-strength bolts herein specified, with the threads excluded from the shear plane.
        a. The length of the bolts shall be such that the nut is flush with the bolt end and does not project beyond the face of the nut more than ½ of an inch.
        b. A hardened washer shall be used beneath the element turned, whether the bolt or the nut, in all field bolted connections to prevent galling of the surface.
    3. The initial flight of each stringer shall be bolted to the floor slab.
I. Install all metal expansion shields and fastenings, anchors and supports in stair well walls as required to stabilize the stairs and landings under stipulated loading conditions and to the satisfaction of the authorities. Secure bottom riser to concrete slab mechanically.
J. Insulate metals where necessary to prevent corrosion due to contact between dissimilar metals and between metals and masonry or concrete. Use bituminous paint, building paper or other approved means.

3.04 TOUCH-UP AND REPAIR OF PRIMED SURFACES

A. Surfaces marred or abraded during erection or field welding shall be repaired as follows:
    1. Remove all weld slag and damaged primer as recommended by the Steel Structures Painting Council and the repair paint manufacturer.
    2. Apply the repair paint herein specified by a method that will result in an even, thorough cover and at a rate that will result in a DFT of not less than two (2) mils.

3.05 FIELD PAINTING

A. The finish, other than painting, applied to the treads, risers and landings shall be as indicated on the Drawings.
B. Field paint all portions of the steel stairs in accordance with the pertinent provisions of Section 09 9000, industrial enamel.

3.06 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.

DIVISION 05 51 33 – METAL LADDERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop-fabricated metal ladders.
B. Prefabricated ladders.
C. Prefabricated ship ladders.

1.02 RELATED REQUIREMENTS

A. *Division 05 51 00* - Metal Stairs.
B. *Division 09 90 00* - Painting and Coating: Paint finish.

1.03 REFERENCE STANDARDS

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.
F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
H. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
I. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2018, with Editorial Revision.
J. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
K. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019.
L. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
M. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
O. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
P. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
Q. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
R. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
S. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
T. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
U. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Shop Drawings:
   1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

D. Designer's Qualification Statement.
E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

A. Design Metal Ladders under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.
C. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.
B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
C. Plates: ASTM A283/A283M.
D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
E. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
F. Bolts, Nuts, and Washers: ASTM A307, plain.
G. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B211/B211M, 6063 alloy, T6 temper.
B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.
F. Aluminum-Alloy Die Castings: ASTM B85/B85M.
G. Bolts, Nuts, and Washers: Stainless steel.
H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED LADDERS (CONTRACTOR OPTION FOR INTERIOR LADDERS)

A. Wall Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
    1. Side Rails: 3/8 by 2 inches members spaced at 20 inches.
    2. Rungs: One inch diameter solid round bar spaced 12 inches on center.
    3. Space rungs 7 inches from wall surface.

2.05 PREFABRICATED LADDERS (EXTERIOR AND CONTRACTOR OPTION FOR INTERIOR LADDERS)

A. Prefabricated Wall Ladders: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
    1. Components: Manufacturer's standard rails, rungs, treads, handrails. returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.

2. Materials: Aluminum; ASTM B211/B211M 6063 alloy, T52 temper.
3. Interior Finish: Mill finish aluminum.
4. Exterior Finish: Powder coat; color to be selected by Architect/Engineer from manufacturer's standard range.
5. Manufacturers:
    a. Basis of Design: O'Keeffe's Inc.; www.okeeffes.com/#sle.
        1) Interior: Standard Duty Channel Rail Model 500.
        2) Exterior Roof Access at Gutters and Low Parapets: Heavy Duty Tubular Low Rail Low Parapet Access w/ roof over rail extensions (with extra length wall brackets to bypass gutter) Model 502.
        3) Exterior Roof Access at High Parapets: Heavy Duty Tubular High Parapet Access Ladder w/ platform and return Model 503.
    b. Precision Ladders, LLC; Fixed Aluminum Wall Ladder: www.precisionladders.com/#sle.
    c. Approved equal.
    d. Substitutions: See *01 25 00 / 01 60 00* - Product Requirements.

B. Prefabricated Ship Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
1. Components: Manufacturer's standard rails, rungs, treads, handrails. returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
2. Materials: Aluminum; ASTM B211/B211M 6063 alloy, T52 temper.
3. Incline: 75 degrees.
4. Finish: Mill finish aluminum.
5. Manufacturers:
    a. Basis of Design: O'Keeffe's Inc; Model 520, 75 degree; www.okeeffes.com/#sle.
    b. Precision Ladders, LLC; Aluminum Ship Stairs: www.precisionladders.com/#sle.
    c. Approved equal.
    d. Substitutions: *01 25 00 / 01 60 00* - Product Requirements.

2.06 FINISHES - STEEL

A. Prime paint steel items.
1. Do not prime surfaces in direct contact with concrete.
2. Do not prime surfaces where field welding is required.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.
C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
D. Prime Painting: One coat.
E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.07 FINISHES - ALUMINUM

A. Exterior Aluminum Surfaces: Paint, Urethane over chemically pretreated substrate. Color: RAL 7015 or otherwise match wall color being attached to..
B. Interior Aluminum Surfaces: Class I color anodized.
C. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.08 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.
B. Maximum Offset Between Faces: 1/16 inch.
C. Maximum Misalignment of Adjacent Members: 1/16 inch.
D. Maximum Bow: 1/8 inch in 48 inches.
E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.
B. Supply setting templates to the appropriate entities for steel items required to be cast into

concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Field weld components as indicated on drawings.
D. Perform field welding in accordance with AWS D1.1/D1.1M.
E. Obtain approval prior to site cutting or making adjustments not scheduled.
F. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.

3.04 *TOLERANCES*

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.
C. Maximum Out-of-Position: 1/4 inch.

DIVISION 05 52 13 – PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall mounted handrails.
B. Stair railings and guardrails.
C. Free-standing railings at walls with grade transitions.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.
B. *Division 03 30 00* - Cast-in-Place Concrete: Placement of anchors in concrete.
C. *Division 04 20 00* - Unit Masonry: Placement of anchors in masonry.
D. *Division 05 50 00* - Metal Fabrications.
E. *Division 05 51 00* - Metal Stairs: Handrails other than those specified in this section.
F. *Division 05 53 05* - Metal Gratings and Floor Plates: Mechanical Areaway protection.
G. *Division 09 90 00* - Painting and Coating

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
B. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
C. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
D. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013.
E. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
F. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, including paints, describing physical and performance characteristics.
C. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
    1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
D. Samples: Submit two, 12-inch-long samples of handrail. Submit two samples of elbow, wall bracket, and end stop.
E. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.
F. Designer's Qualification Statement.
G. Fabricator's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this

work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.

C. Fabricator Qualifications:
   1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
   2. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

D. Allow for expansion and contraction of members and building movement without damage to connections or members.

E. Dimensions: Refer to drawings for additional configurations and heights.
   1. Stainless Steel Handrails: 1-1/2 inches diameter, round.
   2. Rails at picket guards: 1-1/2 inches diameter, round.
   3. Rails at panel guards: 2 inches x 3 2 x 3 inchesrectangular2 x 3 inches, rectangular.
   4. Posts at picket guards: 1-1/2 inches diameter, round.
   5. Posts at panel guards: 2 inches square.
   6. Balusters at picket guards: 1/2 inch square solid bar.

F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

G. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STAINLESS STEEL SYSTEM

A. Tubing: ASTM A554, Grade MT 304.

B. Pipe: ASTM A312, Grade TP 304.

C. Bars, Plates, Sheets, and Shapes: ASTM A240 or ASTM A666, Type 304.

D. Castings: ASTM A743, Grade CF 8 or CF 20.

E. Splice Connectors: Stainless steel, concealed spigots, welding collars, or threaded rod.

F. Exposed Fasteners: Stainless steel, flush countersunk screws or bolts; consistent with railing design.

G. Anchors: Stainless steel; selected to meet structural performance requirements and substrate conditions.

H. Wall Brackets: 316 satin stainless rotating wall mount handrail bracket kit. Basis of Design: Wagner MB3300W with 3-1/2” projection where NFPA Life Safety Code is listed as applicable code. Wagner MB3250W at all other locations.

I. Post Brackets 316 satin stainless post mount handrail bracket. Basis of Design: Wagner MB3300P with 3-1/4” projection where NFPA Life Safety Code is listed as applicable code. Wagner MB3250P at all other locations.

2.03 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
   1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
   3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Weld connections that cannot be shop welded due to size limitations.
   1. Weld in accordance with AWS D1.1/D1.1M.
   2. Match shop welding and bolting.
   3. Clean welds, bolted connections, and abraded areas.
   4. Touch up shop primer and factory-applied finishes.
   5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

F. Stainless Steel Finish: No. 4.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.
B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.
C. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
C. Install railings in compliance with ADA Standards for accessible design at applicable locations.
D. Anchor railings securely to structure.
E. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.
F. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.
C. Maximum Out-of-Position: 1/4 inch.

DIVISION 05 53 05 – METAL GRATINGS AND FLOOR PLATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed metal floor, mezzanine, and stair tread gratings.
B. Mechanical areaway gratings.
C. Perimeter closure.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00*: Framed opening in cast-in-place concrete.
B. *Division 05 12 00*: Framed opening in structural steel framing.
C. *Division 05 51 33* - Metal Ladders.
D. *Division 09 90 00* - Painting and Coating: Field paint finish.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.

E. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015 (Reapproved 2021).
F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.
G. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012.
H. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012.
I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
M. NAAMM MBG 531 - Metal Bar Grating Manual; 2017.
N. NAAMM MBG 532 - Heavy Duty Metal Bar Grating Manual; 2019.
O. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
P. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
Q. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide span and deflection tables.
C. Shop Drawings: Indicate details of component supports, openings, perimeter construction details, and tolerances.
    1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
D. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
E. Manufacturer's Installation Instructions: Indicate special requirements for opening and perimeter framing.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design gratings and plates under direct supervision of a licensed Professional Engineer experienced in design of this type of work.
B. Designer Qualifications: Design gratings and plates under direct supervision of a Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: McNichols Company; www.mcnichols.com.
B. All American Grating, Inc.: www.floor-gratings.com/all-american-grating.
C. Fisher & Ludlow - Div. of Harris Steel Limited; www.fisherludlow.com.
D. Ohio Gratings, Inc.; www.ohiogratings.com.
E. Approved Equal.
F. Substitutions: *01 25 00* - Substitution Procedures.

2.02 PERFORMANCE REQUIREMENTS

A. Comply with applicable code for loading requirements.
B. Load Design: NAAMM MBG 531.
C. Design Live (Pedestrian) Load: Uniform load of 100 lb/sq ft min.; concentrated load of 300 lbs.
D. Maximum Allowable Deflection Under Live Load: 1/240 of span; size components by single support design.

2.03 MATERIALS

A. Steel Floor Plate: ASTM A786/A786M; manufacturer's standard pattern.
B. Sheet Steel for Die Stamping: ASTM A1011/A1011M Designation CS hot-rolled sheet.
C. Steel For Welding or Riveting: ASTM A36/A36M unfinished, of shapes indicated.
D. Steel Sheet for Lock Forming: Hot-dipped galvanized, ASTM A653/A653M, FS Type B, with

G90/Z275 coating.

E. Steel Framing: ASTM A36/A36M shapes, unfinished.
F. Aluminum For Lock Forming: ASTM B221 ASTM B221M extruded, shapes as indicated.
G. Cross Bars: ASTM B211 (ASTM B211M) solid bars.
H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.04 ACCESSORIES

A. Fasteners and Saddle Clips: Galvanized steel: Flange Bocks, J-Hooks.
B. Perimeter Closure: Of same material as grating.

2.05 FABRICATION

A. Grating Type 1: McNichols Bar Grating
   1. Swage-Locked, T-Bar, TB-940-150 - SAFE-T-GRID®, ADA Compliant, 19-S-4 Spacing, Aluminum, Alloy 6063-T6, Mill Finish, 1-1/2" Height x 0.940" Top Flange Width T-Bar Bearing Bars, Spaced 1-3/16" on Center with 0.2475" Clear Space Between Bearing Bar Top Flanges, Grooved Surface, (ADA Compliant Product When Direction of Bearing Bars (Span) Installed Perpendicular to Dominant Direction of Travel), Bearing Bars Run Parallel to Length of Panel, Cross Bars Spaced 4" on Center, 21% Open.
B. Grating Type 2: McNichols Bar Grating
   1. Swage-Locked, Rectangular Bar, GAL-150, 19-S-4 Spacing, Aluminum, Alloy 6063-T6, Mill Finish, 1-1/2" Height x 3/16" Thick Rectangular Bearing Bars, Spaced 1-3/16" on Center with 1" Clear Space Between Bearing Bars, Smooth Surface, Bearing Bars Run Parallel to Length of Panel, Cross Bars Spaced 4" on Center, 80% Open.
C. Fabricate grates and plates to accommodate design loads.
D. Mechanically clinch joints of intersecting metal sections.
E. Fabricate support framing for openings.
F. Provide hinges and padlock hasp at hatch.

2.06 FINISHES

A. Prepare surfaces to be primed in accordance with SSPC-SP 2.
B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
C. Do not prime surfaces in direct contact with concrete or where field welding is required.
D. Prime paint items with one coat.
E. Galvanizing for Steel Shapes: ASTM A123/A123M.
F. Galvanizing for Steel Hardware: ASTM A153/A153M.
G. Aluminum: Mill finish.
H. Non-Slip Surfacing: Aluminum oxide.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated on drawings.
B. Verify that opening sizes and dimensional tolerances are acceptable.
C. Verify that supports are correctly positioned.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions.
B. Place frames in correct position, plumb and level.
C. Mechanically cut galvanized finish surfaces. Do not flame cut.
D. Anchor by welding.
E. Set perimeter closure flush with top of grating and surrounding construction.
F. Secure to prevent movement.

3.03 TOLERANCES

A. Comply with NAAMM MBG 531.
B. Comply with NAAMM MBG 532.
C. Maximum Space Between Adjacent Sections: 1/4 inch.
D. Maximum Variation From Top Surface Plane of Adjacent Sections: 1/4 inch

DIVISION 06 10 00 – ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rough opening framing for roof openings.
B. Preservative treated wood materials.
C. Fire retardant treated wood materials.
D. Communications and electrical room mounting boards.
E. Concealed wood blocking, nailers, and supports.
F. Miscellaneous wood nailers, furring, and grounds.
G. Engineered blocking at top of parapet walls.

1.02 RELATED REQUIREMENTS

A. *Division 06 41 00* - Architectural Wood Casework.
B. *Division 07 54 00* - Thermoplastic Membrane Roofing: Wood nailers and blocking.
C. *Division 07 72 00* - Roof Accessories: Prefabricated roof curbs.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
B. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
D. AWPA U1 - Use Category System: User Specification for Treated Wood; 2012.
E. PS 2 - Performance Standard for Wood Structural Panels; 2018.
F. PS 20 - American Softwood Lumber Standard; 2010.
G. SPIB (GR) - Standard Grading Rules; 2021.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide technical data on wood preservative materials, application instructions, engineered wood products, underlayment, metal framing anchors, and construction adhesives.
C. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:
    1. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure used, net amount of preservative retained, and compliance with applicable standards.
    2. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to project site.
    3. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials.
D. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.
C. Deliver the materials to the job site and store, all in a safe area, out of the way of traffic, and shored up a minimum of 6" above the ground.
D. Use all means necessary to protect lumber materials before, during and after delivery to the job site, and to protect the installed work and materials of all other trades.

1.06 QUALITY ASSURANCE

A. Identify lumber with a visible grade stamp of an agency certified by West Coast Lumber Manufacturers Association or Southern Pine Inspection Bureau (SPIB) and NFPA.
B. Identify plywood as to species, grade and glue type by the stamp of the American Plywood Association.

C. Pressure treated materials shall conform to AWPA Standards.
D. Engineered Blocking: AWPA Standards: Materials shall meet AWPA U1-15 for Use Category UC 2. Service conditions for UC2 are interior construction, above ground, damp; protected from weather but may be subject to sources of moisture.
E. Engineered Blocking: NAHB Green Approved Product: Materials shall be NAHB Green Approved; StrandGuard TimberStrand LSL is a Green Approved Product for National Green Building Certification, Certificate 00008.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir-Larch or Southern Yellow Pine, unless otherwise indicated.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
   3. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
   4. Source Quality Control: Factory-mark each piece of lumber and plywood with type, grade mark, mill identification mark, and trade o SPIB, APA, and other associations having jurisdictions.
   5. Lumber:
      a. Standard yard "Dimension" lumber, graded and sized in compliance with NIST PS 20 and SPIB.
         1) Provide dressed lumber, S4S, unless otherwise indicated.
         2) Provide seasoned lumber with maximum 19% moisture content, "S-Dry" or "KD-19".
      b. General Utility Purposes; Plates, Blocking, Bracing, Nailers, and Grounds: Utility Grade or No. 3 Boards, Southern Pine, pressure treated.
      c. Framing: Southern Pine, in following grades, graded under SPIB rules.
         1) General Light Framing: No. 2 Dimensions, 1200 psi "f" or Standard Grade.
         2) Structural Light Framing: No. 2 Grade.
         3) Structural Framing: No. 2 Grade.
         4) Exposed Framng Lumber: Select Structural Grade.
         5) Paint Finish Exposed Boards: No. 1 Grade.
   6. Plywood: Group 1, fir plywood graded and sized in compliance with NIST PS 1 and APA PRP-108. Provide seasoned plywood with maximum 15% moisture content.
      a. Concealed Plywood:
         1) Exterior: APA C-C Plugged EXT.
         2) Interior: APA C-D Pluged INT, with exterior glue. Provide exterior plywood, APA C-C Plugged EXT, with exterior glue for interior areas exposed to high humidity or moisture.
      b. Plywood Backing Panels: APA C-D Plugged Exposure I, fire-retardant treated panels, in thickness indicated, or minimum 1/2 inch thick when not indicated.
         1) For mounting electrical and telephone equipment.
B. Provide wood harvested within a 500-mile radius of the project site.
C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Fire-Retardant Materials, Interior Type A:
      a. Baxter: J.H. Baxter Co.
      b. Chemical Specialties, Inc.
      c. Continental Wood Preservers, Inc.
      d. Hickson Corp.
      e. Hoover Treated Wood Products, Inc.
   2. Metal Framing Anchors:
      a. Cleveland Steel Specialty Co.
      b. Harlen Metal Products, Inc.

c. Silver Metal Products, Inc.
d. Simpson Strong-Tie Company, Inc.
e. USP Structural Connectors

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
B. Sizes: Nominal sizes as indicated on drawings, S4S.
C. Moisture Content: S-dry or MC19.
D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
1. Lumber: S4S, No. 2 or Standard Grade.
2. Boards: Standard or No. 3.

2.03 ACCESSORIES

A. Fasteners and Anchors:
1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
3. Anchors: Toggle bolt type for anchorage to hollow masonry.
4. Nails, Spikes, Staples: Galvanized for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations; size and type to suit application.
5. Bolts, Nuts, Washers, Lags, Pins, and Screws: Medium carbon steel; sized to suit applications; galvanized for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations.
6. Fasteners:
a. Toggle bolt type for anchorage to hollow masonry, expansion shield and lag bolt type for anchorage to solid masonry or concrete bolts or powder actuated type for anchorage to steel or concrete.

2.04 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
B. Fire Retardant Treatment:
1. Products:
a. Lonza Group: www.wolmanizedwood.com/#sle.
b. Hoover Treated Wood Products, Inc: www.frtw.com/#sle.
c. Koppers, Inc: www.koppersperformancechemicals.com/#sle.
d. UFP Industries; ProWood FR Lumber: www.ufpi.com/#sle.
e. Substitutions: *01 25 00* - Substitution Procedures.
2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
b. Interior rough carpentry items are to be fire retardant treated.
c. Treat rough carpentry items as indicated.
d. Do not use treated wood in applications exposed to weather or where the wood may become wet.
3. Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, US Testing, Timber

Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
    a. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5564, for lumber and ASTM D 5516, for plywood.
    b. Use treatment that does not promote corrosion of metal fasteners.
    c. Use Exterior Type for exterior locations and where indicated.
    d. Use interior Type A High Temperature (HT), unless otherwise indicated.

C. Preservative Treatment:
    1. Products:
        a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
        b. Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com/#sle.
        c. Viance, LLC: www.treatedwood.com/#sle.
        d. Substitutions: *01 25 00* - Substitution Procedures.
    2. Preservative Pressure Treatment of Lumber Above Grade: 1, Use Category UC3B, Commodity Specification Ausing waterborne preservative to 0.10 lb/cu ft retention.
        a. Treat lumber exposed to weather.
        b. Treat lumber in contact with roofing, flashing, or waterproofing.
        c. Treat lumber in contact with masonry or concrete.
        d. Treat lumber less than 18 inches above grade.
        e. Treat lumber in other locations as indicated.
    3. Preservative Pressure Treatment of Plywood Above Grade: 1, Use Category UC2 and UC3B, Commodity Specification Fusing waterborne preservative to 0.25 lb/cu ft retention.
        a. Treat plywood in contact with roofing, flashing, or waterproofing.
        b. Treat plywood in contact with masonry or concrete.
        c. Treat plywood less than 18 inches above grade.
        d. Treat plywood in other locations as indicated.
    4. Preservative Treatment: Where lumber or plywood is specified herein or shown on drawings to be treated, comply with applicable requirements of AWPA Standards C2 (Lumber) and C9 (Plywood) and of AWPB Standards listed below. Mark each treated item with the AWPB Quality Mark requirements.
        a. Pressure-treat above-ground items with waterborne preservatives complying with AWPB LP-2. After treatment, kiln-dry to a maximum moisture content of 15%.
        b. Treat wood nailers, curbs, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers and waterproofing. Also treat wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry, concrete or plaster.

2.05 ENGINEERING BLOCKING

A. Acceptable Manufacturer: PreBuck of Wyoming, MI; Tel: 616-309-6256; Web: http://www.prebuckproducts.com.

B. Parapet Cap Engineered Framing System: StrandGuard TimberStrand LSL 1.30E Engineered Lumber by PreBuck Engineered Framing Systems.
    1. Meets AWPA U1-15 for Use Category 2 (UC2).
    2. NAHB Research Center Green Approved.
    3. MDI resin, 100 percent waterproof when cured.
    4. Treated with zinc borate through complete cross section.
    5. Typical material 1-1/2 inches (38 mm) thick; built-up as required.
    6. Round 1-1/4 inch counter sunk anchor openings at 24 inches O.C.
    7. Acceptable for direct contact with concrete, non-corrosive to metals, insect and fungi resistive.
    8. Materials: StrandGuard TimberStrand LSL 1.30E Engineered Lumber, ICC ESR-1387.
        a. Treatment: Zinc borate through complete cross section.
        b. Bending Strength: 1900 psi.
        c. Tensile Strength: 1075 psi.
        d. Shear Strength: 150 psi.

e. Compression - Perpendicular to Grain: 670 psi.
f. Specific Gravity: 0.50 into the face, 0.42 into the edge.
g. R-value of 1-1/2 inch thickness (ASTM E 518): 1.86.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.
B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including shims, bracing, and blocking.
C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
D. Provide the following specific nonstructural framing and blocking:
    1. Cabinets and shelf supports.
    2. Wall brackets.
    3. Handrails.
    4. Grab bars.
    5. Towel and bath accessories.
    6. Wall-mounted door stops.
    7. Chalkboards and marker boards.
    8. Wall paneling and trim.

3.04 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.
C. At parapet caps, provide one of the following:
    1. Delegated-design of treated lumber with engineered anchorage (fastener size and spacing) into top of structural wall to comply with ES-1. Blocking at parapet caps to be 1 ½ inch minimum thickness.
    2. Engineered framing system with factory applied slope of width indicated with engineered anchorage (fastener size and spacing) into top of wall to comply with ES-1.

3.05 FASTENING

A. Nailing
    1. Use only common wire nails or spikes of the dimension shown on the Nailing Schedule, except where otherwise called for on the drawings.
    2. For conditions not covered in the Nailing Schedule, provide penetration into the piece receiving the point of not less than is the length of the nail or spike provided; however, 16d nails may be used to connect two pieces of two-inch nominal thickness.
    3. Do all nailing without splitting wood. Pre-bore as required. Replace all split members.
B. Bolting
    1. Drill holes 1/16 inch larger in diameter than the bolts being used. Drill straight and true from one side only. Bolt threads shall not bear on wood. Use washers under head and nut where both bear on wood; use washers under all nuts.
C. Screws
    1. For lag screws and wood screws, pre-bore holes same diameter as root of thread; enlarge holes to shank diameter for length of shank. Screw, do not drive, all lag screws and wood screws.

3.06 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
B. Allow preservatives to dry prior to erecting members.

3.07 CLEANING

A. Waste Disposal:
   1. Comply with applicable regulations.
   2. Do not burn scraps on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill and dispose of in a manner acceptable to authorities having jurisdiction.
C. Prevent sawdust and wood shavings from entering the storm drainage system.
D. Keep the premises in a neat, safe, and orderly condition at all times during execution of this portion of the work, free from accumulation of sawdust, cut ends, and debris.

DIVISION 06 41 00 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.
B. Hardware.
C. Factory finishing.
D. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.
B. *Division 06 10 00* - Rough Carpentry: Support framing, grounds, and concealed blocking.
C. *Division 09 64 66* - Wood Athletic Flooring: Hardwood Planks.
D. *Division 12 36 00* - Countertops.

1.03 REFERENCE STANDARDS

A. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
B. ANSI A208.1 - American National Standard for Particleboard; 2009.
C. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).
F. BHMA A156.9 - Cabinet Hardware; 2020.
G. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2009.
H. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
C. Product Data:
   1. Provide data for hardware accessories.
   2. Provide data on specified products, including adhesives, sealants, composite wood and agrifiber, describing physical and performance characteristics.
D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
2. Single Source Responsibility: Provide and install this work from single fabricator.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.08 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
B. Plastic Laminate Faced Cabinets: Premium grade.
C. Cabinets:
1. Finish - Exposed Exterior Surfaces: Decorative laminate.
2. Finish - Exposed Interior Surfaces: Decorative laminate.
3. Finish - Semi-Exposed Surfaces: Decorative laminate
4. Finish - Concealed Surfaces: Manufacturer's option.
5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
6. Door and Drawer Front Retention Profiles: Fixed panel.
7. Casework Construction Type: Type A - Frameless.
8. Interface Style for Cabinet and Door: Style 2 - Finish Inset; reveal overlay.
9. Adjustable Shelf Loading: 40 psf.
a. Deflection: L/144.
10. Cabinet Style: Flush overlay.
11. Drawer Side Construction: Multiple-dovetailed.
12. Drawer Construction Technique: Dovetail joints.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.
B. Provide sustainably harvested wood, certified or labeled; see *Division 01 60 00*.
C. Provide wood harvested within a 500-mile radius of the project site.

2.03 PANEL CORE MATERIALS

A. Particleboard: Composite panel composed of cellulosic particles, additives, and bonding system; comply with ANSI A208.1.
1. Grade: M-2; moisture resistance: MR10.
2. Panel Thickness: 1/2 inch.
B. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.
1. Grade: 115; moisture resistance: MR10.
2. Panel Thickness: 1 inch.
C. Basic Hardboard: Panel manufactured from inter-felted lignocellulosic fibers consolidated under heat and pressure; comply with ANSI A135.4.
1. Class: Tempered.
2. Surface: Smooth one side (S1S).
3. Nominal Thickness: 1/4 inch.

2.04 HARDWOOD PLYWOOD PANELS

A. Hardwood Plywood: Plywood manufactured for nonstructural decorative applications; consisting of faces and backs applied to a variety of core types; comply with HPVA HP-1.
1. Woodwork Quality Standard: Panels complying with specified woodwork quality standard.
2. Face: Birch; plain-sliced; grade AA.
a. Finish: Natural, unfinished.
3. Core, Veneer Core:
a. Inner Plies: Grade J.
b. Construction and Thickness: 5 plies, 3/8 inch.

2.05 HARDWOOD PLANKS

A. Hardwood Planks: Hardwood planks for benches.

1. Woodwork Quality Standard: Complying with specified woodwork quality standard.
    a. 25/32" X 2-1/4", Second & Better Grade, Northern Hard Maple Flooring, TGEM, MFMA marked and stamped as manufactured by Connor Sports Flooring, Amasa, MI
    b. Finish: Natural, unfinished.
2. Products:
    a. Basis of Design: Refer to *09 65 66* - Gym Flooring.
    b. Approved Equal.
    c. Substitutions: See *01 60 00* - Product Requirements.

2.06 THERMALLY FUSED LAMINATE PANELS

A. Not Allowed

2.07 LAMINATE MATERIALS

A. Manufacturers:
    1. Basis of Design: As indicated on drawings.
    2. Approved Equal.
    3. Substitutions: See *Division 01 60 00* - Product Requirements.
B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
C. Provide specific types as indicated.
    1. Vertical Surfaces: VGS, 0.028-inch nominal thickness, through color, finish as indicated.
    2. Cabinet Liner: CLS, 0.020-inch nominal thickness, through color, white color, finish as indicated.

2.08 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.
B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self-locking serrated tongue; of width to match component thickness.
    1. Color: To match laminate.
    2. Use at all exposed plywood edges.
    3. Use at all exposed shelf edges.
C. Fasteners: Size and type to suit application.
D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
E. Concealed Joint Fasteners: Threaded steel.
F. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.09 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self-rests, polished chrome finish, for nominal 1 inch spacing adjustments.
    1. Products:
        a. Basis of Design: Rockler, Shelf Standard: www.rockler.com.
        b. Hardware Resources; www.hardwareresources.com
        c. Approved Equal.
        d. Substitutions: See *Division 01 60 00* - Product Requirements.
C. Countertop Support Brackets: Fixed, L-shaped, face-of-stud mounting.
    1. Materials: Steel; T-shape cross-section.
        a. Finish: Manufacturer's standard, factory-applied, powder coat.
        b. Color: As selected by Architect/Engineer.
        c. Height: 18 inches.
        d. Support Length: 18 inches.
        e. Width: 1 inch.
    2. Products:
        a. Basis of Design: A&M Hardware, Inc; Hybrid Brackets: www.aandmhardware.com/#sle.
        b. Centerline Brackets; Front Mounting Countertop Support: www.countertopbracket.com/#sle.

c. Rakks/Rangine Corporation; Eclipse Brackets: www.rakks.com/#sle.
d. Approved Equal.
e. Substitutions: See *01 60 00* - Product Requirements.

D. Drawer and Door Pulls: "U" shaped wire pull, 3/16" diameter heavy duty, 4" or 5" brushed aluminum wire pull.
1. Products:
a. Basis of Design: Amerock: www.amerock.com.
b. Hardware Resources; www.hardwareresources.com
c. Approved Equal.
d. Substitutions: See *01 60 00* - Product Requirements.

E. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
1. Products:
a. Basis of Design: Hafele America Co; National Lock No. 232.14: www.hefele.com.
b. CompX Timberline; www.compx.com
c. Approved Equal.
d. Substitutions" See *Division 01 60 00* - Product Requirements.

F. Drawer Slides:
1. Type: Ball-bearing slides.
2. Static Load Capacity: Commercial Grade. 100 lb. capacity.
3. Mounting: Side mounted.
4. Stops: Integral type.
5. Features: Provide self-closing/stay closed type.
6. Manufacturers:
a. Basis of Design: Accuride International, Inc; Heavy-Duty Drawer Slides: www.accuride.com/#sle.
b. Blum, Inc; MOVENTO: www.blum.com/#sle.
c. Knape & Vogt Manufacturing Company; Heavy-Duty Drawer Slides: www.knapeandvogt.com/#sle.
d. Approved Equal.
e. Substitutions: See *01 60 00* - Product Requirements.

G. Hinges: Heavy-duty 5-knuckle hinges, steel with nickel-plated finish.

2.10 FABRICATION

A. Assembly: Shop-assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
2. Cap exposed plastic laminate finish edges with material of same finish and pattern.

2.11 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.

C. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.

D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
1. Transparent:
a. Sheen: Flat.
2. Opaque:
a. System - 1, Lacquer, Nitrocellulose.
b. Color: As selected by Architect/Engineer.
c. Sheen: Flat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.
B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
C. Use fixture attachments in concealed locations for wall mounted components.
D. Use concealed joint fasteners to align and secure adjoining cabinet units.
E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
F. Secure cabinets to floor using appropriate angles and anchorages.
G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

A. Adjust installed work.
B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

DIVISION 06 83 16 – FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

STANDARDS: Specify to comply with "Architectural Woodwork Standards" published jointly by Architectural Woodwork Institute (AWI), Architectural Woodwork Manufacturers Association of Canada (AWMAC), and Woodwork Institute (WI), to the most current and adopted standards. Specify “Premium” Grade Casework. Do not register for the project or apply for certification.

MOCK-UP: At Owner request only, contractors shall provide a supplier location to review an exact product or submit a full-scale mock-up including a base cabinet unit with countertop, wall cabinet and at least one accessible and one non-accessible cubby for review and approval for approval by Architect and/ or Owner prior to fabrication. The mock-up may be incorporated into the finished work after approval.

1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic panels.
B. Trim.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

A. 9 CFR 416.2 - Regulatory Requirements Under the Federal Meat Inspection Act and the Poultry Products Inspection Act, Part 416-Sanitation; current edition.
B. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.
C. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor; 2013a.
D. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
E. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Product Data: Provide data on specified products, including adhesives and sealants, describing physical and performance characteristics

D. Samples: Submit two samples 8 by 10 inch in size illustrating material and surface design of panels.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fiberglass Reinforced Plastic Panels:
   1. Crane Composites, Inc: www.cranecomposites.com/#sle.
   2. Marlite: www.marlite.com/#sle.
   3. Nudo: www.nudo.com/#sle.
   4. Panolam Industries International, Inc; Panolam FRP: www.panolam.com/#sle.
   5. Approved Equal
   6. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 PANEL SYSTEMS

A. Wall Panels Type FRP-1:
   1. Panel Size: 4 by 9 feet.
   2. Panel Thickness: 0.09 inch.
   3. Surface Design: As indicated on drawings.
   4. Color: As indicated on drawings.
   5. Attachment Method: Adhesive only, sealant joints, no trim.

2.03 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
   1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Scratch Resistance: Barcol hardness score greater than 35, when tested in accordance with ASTM D2583.
   4. Impact Strength: Greater than 6 ft lb. force per inch, when tested in accordance with ASTM D256.
   5. Sanitation and Cleanability: Comply with 9 CFR 416.2.

B. Trim: Vinyl; color coordinating with panel.

C. Adhesive: Type recommended by panel manufacturer.

D. Sealant: Type recommended by panel manufacturer; white.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate flatness before starting work.

B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.

C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

E. Install panels with manufacturers' recommended gap for panel field and corner joints.

F. Place trim on panel before fastening edges, as required.

G. Fill channels in trim with sealant before attaching to panel.

H. Install trim with adhesive and screws or nails, as required.

I. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.

J. Remove excess sealant after paneling is installed and prior to curing.

GENERAL NOTES:

PLASTIC LAMINATE:

- Plastic Laminate Vertical Surfaces: .028 inches in thickness, for exterior surfaces shall meet NEMA LD3-2000 VGS standards including thickness. Open shelving shall be CL20.

- Balancing Sheet for laminate surfaces: White high-pressure cabinet-liner, CL20 in thickness shall meet NEMA LD3-2000 CLS standards. Use for balancing exterior surface laminates. No melamine allowed.
- Countertops: .054-inch thickness with heavy gauge backing sheet for balanced construction.

DOORS: Provide full overlay style. Construction and thickness shall be as required to prevent warping. Plywood is an allowed substrate. Particle board substrates are discouraged and will not be accepted. Doors shall be balanced construction. For wardrobe/ teacher cabinet doors, closers shall be provided to prevent opening over extension.

SHELVES: Do not exceed spans of 3' for 3/4" thick shelves without additional support.
COUNTERTOP: MSCS preferred finish is solid surface. For best value engineering practices in specific cases, plastic laminate surface will be reviewed prior to acceptance. Countertops shall be of solid surface or 3/4" CDX Plywood (no formaldehydes permitted). Countertops with sinks must be of solid surface or constructed of CDX plywood. Plastic laminate countertops shall have 3mm edge banding.

BASES: Cabinet sides shall not extend down to the floor. Rubber wall base as specified shall be applied on cabinet bases. Install specified floor under the base cabinets, do not spot flooring at cabinets. Independent end panels must be CDX plywood.

CABINET HARDWARE:
Drawer and Door Pulls: 3/16" diameter heavy duty, 4" or 5" brushed aluminum wire pull or other projecting type without extended ends. Do not use recessed pulls.
Drawer Slides: 100 lb. capacity ball-bearing slides with self-closing feature or catch at closed position. Door Hinges: Specify heavy-duty 5-knuckle hinges. Do not use "European" style hinges.
Door Silencers: Shall be provided at all cabinet doors.
Door/ Drawer Locks: Designer to confirm if keyed lockable hardware is requested. Teacher's cabinets when provided shall be lockable.

PRECAUTIONS: Do not install architectural woodwork until the building is enclosed, the permanent heating and cooling system is in operation, and residual moisture from plaster, concrete, or masonry has dissipated. Temporary moisture and relative humidity control measures will be considered on a case-by-case basis.

RECOMMENDED HEIGHTS: Use ADA compliant countertop heights in all locations and as required by code and applicable ADA recommendations.

DIVISION 07 00 00 - THERMAL AND MOISTURE PROTECTION

GENERAL:

ROOFING SYSTEM: Roof design and specification shall be approved by the MSCS Department of Major Construction representative. **MSCS requires that all Designers consider wall penetration over roof penetration, when possible, to minimize impacts and compromises to building envelope during design**. All new roofs shall have a positive slope minimum 1/4" per foot, utilizing the slope of structural members, (not tapered insulation) to drains, preferably at the perimeter**. Use of interior roof drains is discouraged.** Care shall be taken to provide for building expansion and contraction. All roof systems shall be designed to meet Factory Mutual (FM) current wind uplift requirements and max wind speed design. Medium and Low slope roof systems shall require installers to be certified by the product manufacturer of the same system being installed and proof shall be required. Roof warranty shall include a minimum manufacturer's 20-year, No Dollar Limit, full system warranty, and a 5-year labor warranty.

STEEP SLOPE ROOFS: Steep sloped roofs shall have, but not be limited to the following:

- Standing seam Kynar finished structural metal roofing system or architectural system over deck, utilizing seams that are at least 2 ½" above the plane of the roof panel and secured by means of concealed cleats.
- Kynar finished aluminum should be considered if budget allows.
- A minimum slope of 3 inches per foot shall be maintained.
- Total roof insulation rating for steep slope roofs shall be R30 minimum.
- All poly-iso insulation shall be installed over the roof decking and shall have staggered and

taped joints. Insulation joints should not align with any decking joints to prevent air and moisture infiltration.

MEDIUM SLOPED ROOFS: Standing seam metal roofing and dimensional, fiberglass shingle roofing weighing 300 pounds per square or greater are acceptable.

LOW SLOPE ROOFS: Fully Adhered non-ballasted 60 mil (black) EPDM is preferred. **PVC and TPO membranes will not be accepted.** Minimum slope to point of discharge shall be ¼" per foot. Provide warranty as required by *DIVISION 01 78 00* - SPECIAL WARRANTIES AND MAINTENANCE AGREEMENTS. All roofs' Insulations shall be produced CFC free.

CANOPIES: Provide overhead canopies at primary building entrances. Sheet metal panel systems are recommended for soffit construction. EIFS soffits shall not be used.
ROOF INSULATION: Specify minimum R-30 value for roof systems or minimum required by Energy Code – whichever is greater. Mechanically fasten where possible and adhere to concrete surfaces. Provide 2 layers minimum with joints staggered vertically. No gyp board cover board. Roof insulation shall require certification that insulation meets Thermal Warranty per *DIVISION 01 78 00* - SPECIAL WARRANTIES AND MAINTENANCE AGREEMENTS.

SKYLIGHTS: Skylights are not preferred and shall only be implemented with MSCS Department of Major Construction approval.
WINDOWS/ CLERESTORY: Designer shall consider sun angles in regard to window locations and sizes as related to the facilities location on site. Locations with high sun exposure should provide shaded canopies or awnings when applicable. Interior window shading options will be considered.

ROOF DRAINAGE SYSTEM

- MSCS prefers a continuous metal gutter system on all medium and high sloped roofs. Gutters shall be designed and sized for 100-year weather events and related water run-off velocities specific to valleys, and other roof areas.
- Downspouts shall be sized in association with gutter design and shall terminate into a drainage boot connected to a site drainage system. MSCS preferred downspout adapter for basis of design is the Piedmont Downspout- Model B1 or approved equal.
- All heavy gauge metal downspouts shall be attached to the brick exterior by means and methods recommended by downspout manufacturers.
- Interior roof drains are discouraged.
- Roofing drains routing shall be overhead to the exterior of the building. Under slab drain routing is discouraged and recommended to be routed at the exterior building perimeter.
- MSCS preferred roof drain manufacturers to be used as basis-of-design are Zurn, J.R. Smith, Josam, or approved equal.

COVERED WALKWAYS AND CANOPIES

- Overhead canopies are requested at primary entrances, vehicular and bus drop-offs.
- All canopies and covered walkways will be sloped to drain water from the building.
- All covered walkways should be designed to ensure proper coverage for standing and paths of travel as well as include rain coverage that includes wind-driven rain events.
- Covered walkway eaves shall be located a minimum of 1'-0" from face of curb and gutter to prevent damage from school buses, oversized trucks, and other high height vehicles.
- MSCS recommends that water runoff is tied into the storm water drainage system.
- Covered walkways shall be provided from building additions and auxiliary buildings used for daily educational operations to the main facility to protect students and staff during inclement weather.

DIVISION 07 05 43 – CLADDING SUPPORT SYSTEMS

1.01 SECTION INCLUDES

A. One or more of the following systems:
   1. Composite metal hybrid (CMH) cladding support systems for exterior cladding.
   2. Pultruded fiberglass reinforced polymer (PFRP) cladding support system
   3. Adjustable thermally broken clip systems for exterior cold-formed metal framing.

1.02 RELATED REQUIREMENTS

A. *Division 04 20 00* - Unit Masonry.
B. *Division 05 40 00* - Cold-Formed Metal Framing.
C. *Division 06 10 00* - Rough Carpentry.
D. *Division 07 21 00* - Thermal Insulation.
E. *Division 07 27 00* - Air Barriers.
F. *Division 07 42 13.23* – Metal Composite Material Wall Panels
G. *Division 07 42 13* – Metal Wall Panels
H. *Division 07 92 00* - Joint Sealants.
I. *Division 09 30 00* – Tiling (Exterior)

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
C. ASHRAE Std 189.1 - Standard for the Design of High-Performance Green Buildings; 2020.
D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
G. ASTM C1045 - Standard Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions; 2019.
H. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).
I. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
J. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.
K. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer; 2016.
L. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2017.
M. ASTM D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement; 2020.
N. ASTM D1761 - Standard Test Methods for Mechanical Fasteners in Wood and Wood-Based Materials; 2020.
O. ASTM D6641/D6641M - Standard Test Method for Compressive Properties of Polymer Matrix Composite Materials Using a Combined Loading Compression (CLC) Test Fixture; 2016, with Editorial Revision (2021).
P. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
Q. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
R. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
S. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
T. ICC (IgCC) - International Green Construction Code; 2018.
U. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of

Exterior Wall Assemblies Containing Combustible Components; 2023.

V. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate construction of cladding support system over substrate indicated for proper drainage, flashing, trim, back-up support, soffits, and other related work.

B. Preinstallation Meeting: Conduct a preinstallation meeting at project site at least two weeks prior to start of this work.

1. Attendees: Architect/Engineer, Owner's Representative, cladding support system Manufacturer's Representative, wall cladding Manufacturer's Representative, and other affected installers.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's printed product data for each type of product and component included in cladding support system.

C. Shop Drawings: Submit details of material relationships with adjacent construction, including fastening and anchorage connection details.

1. Provide details on layout, spacings, sizes, thicknesses, and types of cladding systems including fabrication, fastening and anchorage details.
2. Provide details on accessories, connections, and attachment to adjacent and nested (insulation) work.
3. Provide a list of locations where cladding support systems are to be used and indicate depth of product at each location.

D. Certificate: Certify that products of this section meet or exceed specified requirements.

E. Delegated Design Documents: Submit one or more of the following:

1. Comprehensive structural analysis for cladding support systems in compliance with performance requirements and design criteria, signed and sealed by the qualified professional engineer responsible for preparation.
   a. Include structural Finite Element Analysis (FEA) in submittal.
   b. Delegated designer's qualification statement.
2. Technical test data for components, Technical Evaluation Reports and Certificates indicating load capacity, and screw type, size, and spacing pullout data.

F. Test Reports: Submit test report for each listed product for tests performed by qualified testing agency for manufacturer.

G. Designer's qualification statement.

H. Manufacturer's qualification statement.

I. Installer's qualification statement.

J. Testing agency's qualification statement.

K. Specimen warranty.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Perform design under direct supervision of Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1. Code Conformance: Provide documentation that cladding support systems have been evaluated by IAPMO Uniform Evaluation Service and are in compliance with local building code requirements.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

E. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions, erection drawings, and shop drawings.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer’s original, unopened, undamaged containers with identification

labels intact.

B. Comply with manufacturer's written instructions for storage and handling to prevent bending, warping, twisting, and surface, edge, or corner damage.

C. Ensure that insulation panels are protected from exposure to moisture.

D. Ensure system components are kept dry, protected from weather damage, and exposure to open flames.

1.08 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit assembly of this work in accordance with manufacturer's written installation instructions and warranty requirements.

1.09 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals for additional warranty requirements.

B. Special Warranty: Provide manufacturer's standard form that indicates they agree to repair or replace components of composite cladding support system that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to the following:
   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of materials beyond normal weathering.
2. Warranty Period: 5-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 COMPOSITE METAL HYBRID (CMH) CLADDING SUPPORT SYSTEMS

A. MANUFACTURERS

1. Advanced Architectural Products, LLC.
   a. Address: 959 Industrial Drive, Allegan, MI 49010.
   b. Phone: (269) 355-1818.
   c. Website: www.smartcisystems.com.

B. Composite Metal Hybrid (CMH) Cladding Support Systems: Attachment systems consisting of fire-resistant, fiber-reinforced, thermoset resin, load-bearing thermally broken girt material.

1. Girt Reinforcing: Noncorrosive steel inserts, at least 18 gauge, 0.0478 inch and galvanized to G90 in accordance with ASTM A653/A653M extending length of profile at fastening locations.
2. Girt Seals: Integral three-point compression seal and anti-siphon grooves on exterior and interior flanges.
3. Girt Depth: As indicated on drawings.
4. Thermal Transmission: System to limit rate of heat flow crosswise through the profile section following ASTM C1045 to less than applicable watts per 8 foot length and temperature delta of 100 degrees Fahrenheit.
5. Products:
   a. Advanced Architectural Products, LLC; SMARTci GreenGirt 2-in-1 System: www.smartcisystems.com/#sle.

C. Adjustable Composite Metal Hybrid (CMH) Cladding Support Systems: Adjustable attachment systems consisting of fire-resistant, fiber-reinforced, thermoset resin load-bearing thermally broken bracket material.

1. Bracket: Provides insulation retention with integral insulation cleats to receive continuous rail, adjusted within bracket as required for overall system depth.
2. Bracket Reinforcing: Noncorrosive steel inserts, at least 16 gauge, 0.0598 inch and galvanized to G90 in accordance with ASTM A653/A653M for engagement of fasteners.
3. Depth of Base Bracket: As indicated on drawings.
4. Horizontal Spacing: 16 inches on center.
5. Vertical Spacing: 16 inches on center.
6. Rail Material: Composite metal hybrid (CMH).
7. Depth of Rail: As indicated on drawings.
8. Rail Adjustability: At least 50 percent of base bracket depth.
9. Girt Depth: As indicated on drawings.
10. Thermal Transmission: System to limit rate of heat flow crosswise through the profile section following ASTM C1045 to less than applicable watts per 8 foot length and

temperature delta of 100 degrees Fahrenheit.

11. Products:
    a. Advanced Architectural Products, LLC; SMARTci GreenGirt Delta - Horizontal Z-Base: www.smartcisystems.com/#sle.
    b. Advanced Architectural Products, LLC; SMARTci GreenGirt Delta - Horizontal L-Base: www.smartcisystems.com/#sle.
    c. Advanced Architectural Products, LLC; SMARTci GreenGirt Delta - Vertical Z-Base: www.smartcisystems.com/#sle.

D. Attach composite metal hybrid (CMH) system components horizontally to wall assembly as follows:
    1. Exterior sheathing over metal stud framing; see *Division 05 40 00* for metal stud framing and wall sheathing.
    2. Concrete masonry units (CMU); see *Division 04 20 00* for CMU substrate.

E. Provide type of insulation for wall assembly as follows:
    1. Mineral wool board insulation.

F. Thermal Insulation: See *Division 07 21 00* for additional information.

G. Water-Resistive Barriers: See *Division 07 27 00* for additional information.

H. Joint Sealants: Provide sealants at edges and transitions between composite cladding support systems and exterior cladding; see *Division 07 92 00* for additional information.

I. Performance requirements
    1. Design: Engage a qualified professional engineer to design composite cladding support systems; see Section 01 4000 - Quality Requirements for additional information.
    2. System Structural Design: Provide system tested in accordance with ASTM E330/E330M and certified to be without permanent deformation or failure of structural members based on design wind velocities for project location, and probability of occurrence data from wind velocity maps provided in ASCE 7 and as approved by local authorities having jurisdiction (AHJ).
        a. Design Loads: Calculate in accordance with applicable code.
        b. Design Wind Load: As indicated on drawings (positive and negative).
        c. Measure performance in accordance with ASTM E330/E330M, using test load of 1.5 times the design wind pressure and 10 second duration of maximum load.
        d. Use Finite Element Analysis (FEA) to model and evaluate areas of the longest composite girt cantilever span possible between intermediate framing members and/or attachment.
            1) FEA to include maximum dead load and wind load conditions.
            2) FEA to include point loads relating to fastener locations.
            3) Model maximum directional stresses to have a safety factor of 4 or greater.
            4) Indicate and analyze stresses in three directions.
            5) FEA to accurately replicate the wall system and physical loading dynamics.
        e. Abut the ends of adjacent non-interlocking girts and install on surface with width of at least 3 inches or double stud condition to accommodate proper fastener margins for composite cladding support material.
    3. System Thermal Design: Ensure that installed composite cladding support system, insulation, rough opening trim, subframing, clips, and cladding attachments do not contribute to thermal bridging of fasteners or framing by creating a continuous metal path from exterior to interior surfaces of insulation.
        a. Provide system thermal design that meets or exceeds requirements in accordance with ASHRAE Std 90.1 I-P, ASHRAE Std 189.1, ICC (IECC), and ICC (IgCC).
    4. Temperature: Comply with structural loading requirements within a temperature range of minus 55 degrees Fahrenheit to 190 degrees Fahrenheit.
        a. Submit the following tests at the high value (at least 180 degrees Fahrenheit) of the temperature range:
            1) Fastener pullout.
            2) Tensile strength.
                (a) Crosswise (CW).
                (b) Lengthwise (LW).

3) Modulus of elasticity.
(a) Crosswise (CW).
(b) Lengthwise (LW).
4) Engineering calculations that include the following:
(a) Point load calculations of the cladding attachment to the sub-framing.

b. Uniform loading not allowed.
1) Include live and dead load simultaneously modeled.
2) Deflection meeting specified criteria.

c. Performance criteria from high end of the service range to meet the minimum specified properties.

d. Test reports must include data at high end elevated temperatures (at least 180 degrees Fahrenheit); if not included, submittal is not approved.

5. Structural Loading Temperature Range: Comply with loading requirements within temperature range of minus 55 to 180 degrees Fahrenheit.

6. Fire Resistance: Comply with ASTM E119 for testing by a qualified testing agency, and identify products with appropriate markings of applicable testing agency acceptable to local authorities having jurisdiction (AHJ).
a. Flame Spread Index (FSI): 25 or less, following ASTM E84 test method.
b. Smoke Developed Index (SDI): 450 or less, following ASTM E84 test method.
c. Exterior Wall System: Comply with NFPA 285 wall assembly combustible component test.

2.02 COMPOSITE TRIM MATERIAL FOR OPENINGS

A. Nonstructural Composite Material Trim: Provide manufacturer's standard trim, angles, and similar components at transitions and rough openings meeting performance requirements as indicated.
1. Trim Types: Provide angled and flat trim at locations as indicated on drawings.
a. Angled Trim: 2 by 3 inches, nominal.
b. Flat Trim: 6 inches wide, nominal.

2.03 PULTRUDED FIBERGLASS REINFORCED POLYMER (PFRP) CLADDING SUPPORT MEMBER

A. Material: The PFRP cladding support system shall be manufactured using:
1. A pultruded process utilizing premium polyester resin with additional flame-retardant additives.
2. E or E-CR glass rovings and continuous filament mat
3. Synthetic surface veil fabric with embedded STRONGIRT® logo shall encase the glass reinforcement.
4. The width of the girts shall be 2.4” or 8.5” ULTRA or as otherwise indicated on drawings,

B. Process
1. Manufactured by the pultrusion process.

C. Performance Requirements:
1. Achieve a flame spread rating of 25 or less in accordance with ASTM test method E84, the flammability characteristics of UL 94 V-0 and the self-extinguishing requirements of ASTM D-635. All PFRP cladding support members shall contain a UV inhibitor to inhibit damage due to UV exposure.
2. Property:
a. Tensile Strength (LW), minimum 75,000 psi per ASTM D638
b. Tensile Modulus (LW), minimum 4x106 per ASTM D638
c. Short beam shear strength (LW), minimum 5,000 psi per ASTM D2344
d. Screw pullout load, minimum 850 lbf per ASTM D1761
e. Flammability Characteristics:
1) Class A Flame Spread, less than 25 per ASTM E84
2) Class A Smoke Density, less than 250 per ASTM E84
3) NFPA 285 compliant
f. Thermal Conductivity, 2.64 -in/ft2-HR/°F
g. lb per ASTM D5961 (Procedure A)
h. Screw Head Pull-Through Load, 935 lb per ASTM D7332 (Procedure B)

2.04 THERMALLY BROKEN CLIPS FOR STEEL STUDS

A. One of the following:
   1. Composite Metal Hybrid (CMH): GreenGirt CMH Clips as manufactured by Advanced Architectural Products, LLC.
   2. Galvanized angle with thermal isolator: 4.75” Iso Clip as manufactured by Northern Facades Ltd. of Mississauga, ON, Canada
   3. Thermally broken clip as recommended by Cold Formed Metal Framing manufacturer.

2.05 ACCESSORIES

A. Provide manufacturer's standard accessories including, but not limited to, strapping, tie-in brackets, flashings, sealants, tapes, and similar components as necessary for complete thermally broken cladding support system.
B. Fasteners: Provide corrosion-resistant, self-tapping and self-drilling screws, bolts, nuts, and other fasteners as recommended by cladding support system manufacturer suitable for and compatible with system materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify substrates comply with requirements for installation.
B. Start installations only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Ensure that substrate surfaces have been thoroughly cleaned before starting installation.
B. Remove wet insulation panels or allow them to completely dry before installation of cladding support system.
C. Prepare substrate surfaces using methods in accordance with cladding support system manufacturer's written instructions.
D. Properly prepare subframing, base angles, sills, furring, and other cladding support system members and provide anchorage in accordance with ASTM C754 for gypsum panel substrate and exterior cladding type following composite cladding support system manufacturer's written instructions.

3.03 INSTALLATION

A. Install cladding support system products and components following manufacturer's written instructions, approved submittals, and the following:
   1. Install components in proper relationship with adjacent materials.
   2. Install cladding support system assembly level, plumb, and square with a maximum allowable tolerance of 1/4 inch in 20 feet.
   3. Provide required temporary structural supports and bracing to maintain position, stability, and alignment of units until permanent connection or support has been established.
   4. Do not use powder-, air-, or gas-actuated fasteners or actuated fastener tools; do not use impact wrenches when fastening to cladding support system members.
   5. Do not install fasteners within the equivalent distance of three times the fastener diameter of the ends and within two times the fastener diameter of the sides of framing support system members.
B. Install cladding support system to fill in exterior spaces without gaps or voids; do not compress insulation panels.
C. Trim insulation neatly to fit spaces and insulate miscellaneous gaps and voids; fit insulation tightly in spaces within plane of insulation.
D. Seal gaps, voids, or penetrations completely with sealant on exterior and interior areas that are visible to view to prevent condensation within wall space before enclosure.
E. Do not leave exterior wall insulation exposed for periods greater than 60 days without appropriate protection.
   1. When extended exposure is anticipated, protect exposed insulation surfaces, including corners, window, and door openings, with waterproof tape.
F. Install cladding support system in compliance with system orientation, sizes, and locations as indicated on drawings.
   1. Use nonstructural composite material trim at rough openings to properly transition continuous insulation system.
   2. Use trim angles and accessories sized to enclose continuous insulation system to provide

thermally broken transition from opaque wall assemblies.
3. Use sealant and tapes to transition air barrier from substrate onto trim.
4. Trim to provide a 90-degree transition of the continuously insulated substrate for air barrier and exterior flashings.
5. Cover trim with exterior cladding materials and flashings.

3.04 PROTECTION

A. Protect installed components from damage until Date of Substantial Completion.
B. Replace damaged insulation panels before Date of Substantial Completion.

DIVISION 07 05 53 – FIRE AND SMOKE ASSEMBLY IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Identification markings for fire and smoke rated partitions, and fire rated walls.

1.02 RELATED REQUIREMENTS

A. *Division 09 90 00* - Painting and Coating: Paint finish.

1.03 REFERENCE STANDARDS

A. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's printed product literature for each type of marking, indicating font, foreground and background colors, wording, and overall dimensions.
C. Schedule: Completely define scope of proposed marking, and indicate location of affected walls and partitions, and number of markings.
D. Samples: Submit two samples of each type of marking proposed for use, of size similar to that required for project, illustrating font, wording, and method of application.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06 FIELD CONDITIONS

A. Do not install adhered markings when ambient temperature is lower than recommended by label or sign manufacturer.
B. Do not install painted markings when ambient temperature is lower than recommended by coating manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Partition Identification Labels:
1. Basis of Design: Fire Wall Signs, Inc: www.firewallsigns.com/#sle.
2. Safety Supply Warehouse, Inc: www.safetysupplywarehouse.com/#sle.
3. Approved Equal.
4. Substitutions: See *01 60 00* - Product Requirements.

2.02 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

A. Regulatory Requirements: Comply with "Marking and Identification" requirements of "Fire-Resistance Ratings and Fire Tests" chapter of ICC (IBC).
B. Adhered Fire and Smoke Assembly Identification Signs: Printed vinyl or paper sign with factory applied adhesive backing.
C. Applied Fire and Smoke Assembly Identification: Identification markings applied to partition with paint and a code compliant stencil. See *Division 09 90 00* for products.
D. Languages: Provide sign markings in English.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 PREPARATION

A. See *Division 09 90 00* for substrate preparation for painted markings.

3.03 INSTALLATION

A. Locate markings as required by ICC (IBC).

B. Install adhered markings in accordance with manufacturer's instructions.
C. Install applied markings in accordance with *Division 09 90 00*.
D. Install neatly, with horizontal edges level.
E. Protect from damage until Date of Substantial Completion; repair or replace damaged markings.

DIVISION 07 08 00 – COMMISSIONING OF BUILDING ENVELOPE

PART 1 GENERAL – 100% Commissioning is required.

1.1 SUMMARY

A. The work under this Section is subject to requirements of the Contract Documents including the Owner's General Conditions and articles of the Construction Manager's General Conditions.
B. General commissioning requirements are detailed in Division 01.
C. The commissioning process does not reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product in accordance with the Contract Documents.
D. The requirements of this section apply to both Division 07 and Division 08.
E. This section shall in no way diminish the responsibility of the Division 07 and 08 Contractors, Subs and Suppliers in performing all aspects of work and testing as outlined in the contract documents. Any requirements outlined in this section are in addition to requirements outlined in Division 01, 07, and 08 Specifications.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
B. The requirements in this section are in addition to those specifically outlined in:
1. *Division 01 80 00* – Minimum Owner Training Requirements
2. *Division 01 90 00* – General Commissioning Requirements

1.3 BUILDING ENVELOPE COMPONENTS AND SYSTEMS TO BE COMMISSIONED

A. The following components and systems shall be commissioned as part of this project. All general references to equipment and systems within this document refer only to those identified below:
1. Roofs; including roofing material (shingles and tiles, bituminous, EPDM, PVC, fluid-applied, sprayed polyurethane, metal) flashing, roof specialties, and roof accessories
2. Above-grade wall systems; including air barriers, water resistant barriers, exterior insulated finish systems (EIFS), metal wall panels, integrated sheathings, spray polyurethane foam, etc
3. Below-grade systems; including waterproofing, damp proofing, and vapor barriers
4. Glazing Systems; including curtain wall, storefront, punched opening windows, and skylights
5. Exterior Doors; including Revolving, glass leaf, emergency exit, and service
6. Louvers and Vents
7. Sealants; including caulking, tapes, etc.

1.4 REFERENCES

A. Refer to *Division 01 90 00* for applicable references for work associated with this section.

1.5 DEFINITIONS & ABBREVIATIONS

A. Refer to *Division 01 90 00* for definitions and abbreviations for terms in this section.

1.6 COMMISSIONING TEAM

A. Refer to *Division 01 90 00* for commissioning team members.

1.7 COMMISSIONING SUBMITTALS

A. Refer to *Division 01 90 00* for additional required commissioning submittals.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 COMMISSIONING PROCESS OVERVIEW

A. Refer to *Division 01 90 00* for an overview of the commissioning process.

3.2 ROLES AND RESPONSIBILITIES

A. Refer to *Division 01 90 00* for roles and responsibilities of additional team members.

3.3 SCHEDULING AND COORDINATION

A. Refer to *Division 01 90 00* for scheduling and coordination requirements.

3.4 QUALITY CONTROL INSPECTIONS

A. The CxA shall conduct the following inspections as applicable during the installation of the air barrier system and submit quality control reports as indicated below:

1. Inspect to assure continuity of the air barrier system throughout the building enclosure and that all gaps are covered, the covering is structurally sound, and all penetrations are sealed allowing for no infiltration or exfiltration through the air barrier system.
2. Inspect to assure structural support of the air barrier system to withstand design air pressures.
3. Inspect to assure masonry surfaces receiving air barrier materials are smooth, clean, and free of cavities, protrusions, and mortar droppings, with mortar joints struck flush.
4. Inspect and test to assure site conditions for application temperature and dryness of substrates are within guidelines.
5. Inspect to assure substrate surfaces are properly primed if applicable and in accordance with manufacturer's instructions. Priming must extend at least 2 inches beyond the air barrier material to make it obvious that the primer was applied to the substrate before the air barrier material.
6. Inspect to assure laps in materials are at least a 2-inch minimum, shingled in the correct direction or mastic applied in accordance with manufacturer's recommendations, and with no fishmouths.
7. Inspect to assure that a roller has been used to enhance adhesion. Identify any defects such as fishmouths, wrinkles, areas of lost adhesion, and improper curing. Note the intended remedy for the deficiencies.
8. Inspect to assure that the correct materials are installed for compatibility.
9. Inspect to assure proper transitions for change in direction and structural support at gaps.
10. Inspect to assure proper connection between assemblies (membranes and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity, and continuity of seal.

3.5 CONTRACTOR'S TESTS

A. Contractor shall execute all testing as required in other sections of *Division 07* and *Division 08*.

B. Tests shall be scheduled and documented in accordance with all requirements of *Division 01*, including *01 90 00*.

C. The CxA shall be notified sufficiently to allow for witnessing of all required contractor tests as necessary.

3.6 NON-CONFORMANCE AND COMMISSIONING ISSUES

A. Refer to *Division 01 90 00* for information regarding Non-Conformance and Cx Issues.

DIVISION 07 10 00 – WATERPROOFING

PART 1 GENERAL

All below grade wall construction of interior spaces, elevated floor construction at toilet rooms, and shower room floors and walls shall be waterproofed.

1.01 SECTION INCLUDES

A. Sheet Waterproofing

1.02 SYSTEM PERFORMANCE

A. Provide waterproofing membrane installations that form watertight continuous seals.

1.03 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Concrete substrate.

B. *Division 07 00 00* - Thermal Insulation: Insulation used for protective cover.

1.04 REFERENCE STANDARDS

A. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course; 2015.

B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016.

C. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).
D. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2012.
E. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2010).
F. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test); 2008 (Reapproved 2015).
G. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2017.
H. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems; 2014.
I. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 1993, with Editorial Revision (2014).
J. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
K. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a, with Editorial Revision (2013).

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants.
C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
D. Certificate: Certify that products meet or exceed specified requirements.
E. Manufacturer's Installation Instructions: Indicate special procedures.
F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
G. Copies of site observation reports by sheet waterproofing manufacturer’s technical representative

1.06 QUALITY ASSURANCE

A. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.07 FIELD CONDITIONS

A. Do not apply membrane when surface temperature is below or inclement weather conditions conflict with manufacturer’s published requirements.
B. Coordinate waterproofing work with other trades. The applicator shall have sole right of access to the specified areas for the time needed to complete the installation.
C. Warn personnel against breathing of vapors and contact of material with skin or eyes. Wear applicable protective clothing and respiratory protection gear.
D. Keep flammable products away from spark or flame. Do not allow the use of spark producing equipment during application and until all vapors have dissipated. Post “NO SMOKING” signs.
E. Maintain work area in a neat and orderly condition, removing empty containers, rags, and rubbish daily from the site.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.
D. Warranties are subject to the Conditions of the Contract. Manufacturer warranties are supplementary to Contractor’s general warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Carlisle Coatings & Waterproofing Inc; MiraDRI 860/861: www.carlisleccw.com/#sle.

B. Polyguard Products, Inc; 650 Membrane: www.polyguardproducts.com/#sle.
C. Mar-flex Waterproofing & Building Products: www.mar-flex.com/#sle.
D. W.R. Meadows, Inc: www.wrmeadows.com/#sle.
E. Approved Equal.
F. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 WATERPROOFING APPLICATIONS

A. Self-Adhesive Sheet Membrane Waterproofing: Shall be CCW MiraDRI 860/861 consisting of a 56 mils of rubbersized asphalt laminated to 4 mils of polyethylene film to form a minimum of 60-MIL membrane and shall meet or exceed the following requirements:
   1. Thickness: 60 mils, ASTM D 37672.
   2. Tensile Strength (Membrane): 25 psi, ASTM D 4123.
   3. Tensile Strength (Film): 5000 psi, ASTM D 8824.
   4. Elongation: 350% minimum, ASTM D 4125.
   5. Permeance: 0.05 Perm maximum, ASTM E 966.
   6. Flexibility, 180° bend over 1 in. mandrel t -45°F: Unaffected, ASTM D 19707.
   7. Crack Cycling at -25°F (100 cycles): Unaffected, ASTM C 8368.
   8. Peel Strength: 10.0 lb/in, ASTM D 9039.
   9. Lap Adhesion: 19.0 lb/in, ASTM D 1876
   10. Puncture Resistance: 60 lb (min), ASTM E 154
   11. Soil Burial 16 weeks: No Effect, GSA-PBS 07121
   12. Water Absorption: 0.1% by wt., ASTM D 570
   13. Hydrostatic Head: 230 ft., ASTM D 5385
B. For application temperatures between 15°f and 60°f, use CCW 861-ULT sheet membrane and CCW-702, CCW-702LV, or CCW-715. For application temperatures above 40°f use CCW MiraDRI 860/861 sheet membrane and CCW-702, CCW-702lv, CCW-702WB, CCW-715, CCW-AWP, or CAV-GRIP.
C. Location: At all below grade concrete walls adjacent to occupied space, elevator pits, and where waterproofing is indicated on drawings.
D. Cover with protection board.

2.03 ACCESSORIES

A. Surface primer: shall be CCW-702, CCW-702lv, CCW-715, CCW-702WB, CCW-AWP or CAV-GRIP.
B. Mastic: shall be CCW-704 mastic.
C. Sealants: shall be CCW-703 vertical grade liquiseal membrane, CCW-LM-800xl, CCW-201 two-component polyurethane sealant or approved sealant by CCW.
D. Backer rod: shall be closed-cell polyethylene foam rod.
E. Protection course: shall be CCW-protection board-H or HS, CCW-300HV for horizontal surfaces or CCW-protection board-V or CCW-200Vfor vertical surfaces.
F. Drainage composite: shall be CCW MiraDrain as recommended by the manufacturer for each condition.
G. Perimeter drainage system: where required shall be CCW MiraDrain HC.
H. Swellable sealant: shall be MiraSTOP SS for use in non-moving joints to create watertight concrete joints and as an adhesive for CCW MiraSTOP waterstop strips
I. Pre-formed bentonite hydrophilic waterstop strip: shall be CCW MiraSTOP BW for use in non-moving joints to create watertight concrete joints
J. Pre-formed non-bentonite hydrophilic waterstop strip: shall be CCW MiraSTOP NBW for use in non-moving joints to create watertight concrete joints
K. Injectable waterstop (grout tube): shall be MiraSTOP IW for use as an injectable waterstop. For use in non-moving joints to create watertight concrete joints
L. Chemical grout: shall be MiraSTOP CG-F and for use with the MiraSTOP IW
M. Miscellaneous products: accessory products approved by Carlisle Coatings & Waterproofing Inc.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before any waterproofing work is started the waterproofing applicator shall thoroughly examine all surfaces for any deficiencies or unsatisfactory conditions detrimental to the proper completion of the work. Should any deficiencies exist, the architect, owner, or general

contractor shall be notified in writing. Do not proceed with work until all deficiencies or unsatisfactory conditions are corrected.

3.02 SURFACE PREPARATION

A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.

B. Cast-in-place concrete substrates:
   1. Do not proceed with installation until concrete has properly cured and dried (minimum 7 days for normal structural concrete and minimum 14 days for lightweight structural concrete).
   2. Concrete shall be cured by water curing method. Any curing compounds must be of the pure sodium silicate type or clear resin-based materials without waxes, oils or pigments and be approved by the Carlisle representative.
   3. Form release agents must not transfer to the concrete. Remove forms as soon as possible from below horizontal slabs to prevent entrapment of excess moisture. Excess moisture may lead to blistering of the membrane.
   4. Concrete shall be sloped for proper drainage.
   5. Voids, rock pockets and excessively rough surfaces shall be repaired with approved non-shrink grout or ground to match the unrepaired areas. Fill form tie rod holes with concrete and finish flush with surrounding surface.
   6. Two-stage drains shall have a minimum 3 inch flange and be installed with the flange flush and level with the concrete surface.
   7. Surfaces at cold joints shall be on the same plane. Grind irregular construction joints to suitable flush surface.

C. Related Materials: Treat joints and install flashing as recommended by waterproofing manufacturer.

3.03 APPLICATION

A. Refer to manufacturer's literature for recommendations on installation, including but not limited to the following:
   1. Apply primer/contact adhesive at rate recommended by manufacturer. Recoat areas which were not waterproofed the same day or if contaminated by dust. Mask and protect adjoining exposed finish surfaces to protect those surfaces from excessive application of primer.
   2. Do not install membrane until primer/contact adhesive is completely dry. Dry time will vary with weather conditions.
   3. Seal installation at the end of the day with troweled bead of manufacturer's approved sealant
   4. Apply protection board and/or drainage board and other related materials in accordance with manufacturer's recommendations.

B. Verify existing conditions are acceptable prior to starting this work.

C. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

D. Verify items that penetrate surfaces to receive waterproofing are securely installed.

E. Verify that substrates to receive waterproofing are complete and that penetrating work is in place and ready to be finally sealed and covered.

F. Verify that substrate moisture is within limits stated in waterproofing membrane manufacturer's application recommendations.

3.04 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.

C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.

D. Seal cracks and joints with sealant using depth to width ratio as recommended by sealant manufacturer.

E. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by

manufacturer, and protect conditioner from rain or frost until dry.

F. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate according to ASTM D5295/D5295M.
   1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
   2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delamination, as described in the reference standard.
   3. Remove and replace areas of defective concrete as specified in Section 03 3000.
   4. Prepare concrete for adhesive bonded waterproofing using mechanical or chemical methods described in the referenced standard.
   5. Test concrete surfaces as described in the referenced standards. Verify surfaces are ready to receive adhesive bonded waterproofing membrane system.

3.05 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions.
B. Roll out membrane, and minimize wrinkles and bubbles.
C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.
D. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.
E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.
G. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
H. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 6 inches above horizontal surface for first ply and 6 inches at subsequent plies laid in shingle fashion.
I. Seal membrane and flashings to adjoining surfaces.

3.06 INSTALLATION - GENERAL

A. Coordinate installation of waterproof membrane with other constructions to ensure protection of building.
B. Schedule installation to minimize period of exposure of sheet waterproofing materials.
C. Extend waterproofing and flashings as shown to provide complete membrane over area indicated to be waterproofed.

3.07 INSTALLATION – SHEET WATERPROOFING

A. Where recommended by manufacturer, provide cove fillets at transition from horizontal to vertical surfaces.
B. Seal membrane watertight to projections through membrane.
C. Seal seams and exposed termination edges watertight.
   1. Where indicated or recommended by sheet waterproofing manufacturer, apply metal termination bars. Space fasteners as recommended by sheet waterproofing manufacturer, but not more than 12 inches o/c.

3.08 FIELD QUALITY CONTROL

A. Owner will provide testing services in accordance with Section 01 4000 - Quality Requirements. Contractor shall provide temporary construction and materials for testing.
B. Upon completion of horizontal membrane installation, dam installation area in preparation for flood testing.
C. Flood to minimum depth of 1 inch with clean water, and after 48 hours inspect for leaks.
D. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Architect/Engineer; repeat flood test, and repair damage to building.
E. When area is proven watertight, drain water and remove dam.

3.09 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.
B. Install drainage and protection boards over completed waterproofing membrane. Secure protection boards against displacement by subsequent construction operations.

C. Protect completed membrane during installation of work over membrane and throughout remainder of construction period.

DIVISION 07 19 19 – SILICONE WATER & GRAFFITI-RESISTANT TREATMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Water and graffiti resistant treatment applied to exterior exposed masonry walls.
   2. Water and graffiti resistant treatment applied to interior exposed masonry walls.

B. Related Sections:
   1. *Division 01 30 00* - Administrative Requirements.
   2. *Division 04 01 00* - Maintenance of Masonry.
   3. *Division 04 20 00* - Unit Masonry.
   4. *Division 04 30 00* - Cast Stone Masonry.

1.02 REFERENCE STANDARDS

A. ASTM C67- Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
B. ASTM C140- Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
C. ASTM D2369- Standard Test Method for Volatile Content of Coatings.
D. ASTM D6490- Standard Test Method for Water Vapor Transmission of Non-Film Forming Treatments Used on Cementitious Panels.
E. ASTM D6532- Standard Test Method for Evaluation of the Effect of Clear Water Repellent Treatments on Water Absorption of Hydraulic Cement Mortar Specimens.
F. ASTM D7089- Standard Practice for Determination of the Effectiveness of Anti-Graffiti Coating for Use on Concrete, Masonry and Natural Stone Surfaces by Pressure Washing.
G. ASTM E96- Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

1.03 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and *Division 01* General Requirements specification sections.
B. Submit product data including detailed test results of materials applied to surfaces similar to requirements of this Section.
C. Submit manufacturer's instructions for methods and application procedures.
D. Submit manufacturer's certification indicating water and graffiti-resistant treatment conforms to or exceeds requirements stated herein.

1.04 QUALITY ASSURANCE

A. The Contractors involved with work covered by this Section shall have had a minimum of five (5) years experience using specified techniques for water and graffiti-resistant treatment application.
B. Tradesman must be competent and experienced and shall demonstrate reasonable care during performance of operations described in this Section.
C. Tests and Approvals:
   1. Sample Area:
      a. Contractor shall apply a test area of wall surface from four square feet in size for inspection and approval by Architect and Owner’s Representative after treatment has cured. Test area shall be available for comparison during the specified scope of work.
      b. Samples of adjacent materials shall be tested for possible reactions with the water and graffiti-resistant treatment. Such samples shall be available for inspection by the Owner’s Representative.
   2. If any part of this work shall be found defective (because of improper preparation of surfaces or application of treatment) at any time before the final acceptance of the item, the Contractor shall, at his own expense, make good such defect to the satisfaction of the Architect/Engineer.

1.05 PROJECT CONDITIONS

A. Protection:
   1. Contractors shall provide, at all times, covered access to premises and necessary utilities,

space for storage of material and equipment, etc.
2. All activities shall be in compliance with local and governmental regulations and codes.
3. The surface and atmospheric temperature should be at least 40 degrees Fahrenheit. and rising during application and for eight hours following. Surface and air temperatures should not exceed 90 degrees Fahrenheit.
4. Surfaces should be dry.
5. Apply only in well-ventilated areas.
6. All caulking (sealants) should be applied a minimum of 24 hours prior to application, or as required by sealant manufacturer, whichever is greater, before application of water and graffiti-resistant treatment.
7. The Contractor shall require applicators to observe safety precautions as outlined on containers and labels. It is the responsibility of the Contractor to provide well-ventilated areas for all workmen as well as to observe safety precautions as stipulated on labels and instructions of all materials used, and as required by governing authorities during application and drying.

1.06 WARRANTY

A. Warranty: Manufacturer's warranty that water repellant will repel water and will allow water vapor out of substrate for not less than ten (10) years commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 WATER AND GRAFFITI-RESISTANT TREATMENT

A. Water and Graffiti- Resistant Treatment:
   1. Locations: Exterior brick and cast stone,
   2. Use clear-drying, penetrating, water-based silicone emulsion for weatherproofing masonry materials and protecting them from graffiti attacks without altering their natural appearance.
   3. Physical and Performance Properties:
      a. Total Solids per ASTM D2369: Six (6) percent.
      b. Comply with national, state, and district AIM VOC regulations.
      c. Water Absorption Reduction (Brick) per ASTM C67: Greater than 98 percent.
      d. Water Absorption Reduction (CMU) per ASTM C140: Greater than 87 percent.
      e. Water Vapor Transmission per ASTM E96:
         1) Clay Brick: Greater than 99 percent.
         2) Concrete Block: Greater than 95 percent.
         3) Mortar: Greater than 88 percent.
      f. Water Vapor Transmission WVT per ASTM D6490: Minimum 91 percent retention.
   4. Approved Products:
      a. Sure Klean Weather Seal Blok-Guard & Graffiti Control WB 6; PROSOCO, Inc. (Basis of Design).

B. Water and Graffiti- Resistant Treatment:
   1. Locations: Interior brick and Architectural ground face concrete block,
   2. Use clear-drying, penetrating, water-based silicone emulsion for weatherproofing masonry materials and protecting them from graffiti attacks without altering their natural appearance.
   3. Physical and Performance Properties:
      a. Total Solids per ASTM D 2369: Fifteen (15) percent.
      b. Comply with national, state, and district AIM VOC regulations.
      c. Water Absorption Reduction (Brick) per ASTM C 67: Greater than 99 percent.
      d. Water Absorption Reduction (CMU) per ASTM C 140: Greater than 92 percent.
      e. Water Vapor Transmission WVT per ASTM D 6490: Minimum 97 percent retention.
      f. Cleanability Level 2 per ASTM D7089.
   4. Approved Products:
      a. Sure Klean Weather Seal Blok-Guard & Graffiti Control WB 15; PROSOCO, Inc. (Basis of Design).

C. Graffiti Remover:
   1. Product shall be manufactured and approved for use by the water and graffiti-resistant treatment manufacturer.
   2. Approved Products:
      a. Enviro Klean SafStrip; PROSOCO, Inc.

b. Enviro Klean SafStrip 8; PROSOCO, Inc.
c. Sure Klean Graffiti Remover; PROSOCO, Inc.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify surfaces to receive water and graffiti-resistant treatments are clean, free of efflorescence, oil, grease, or other foreign matter detrimental to application.
B. Remove loose particles and foreign matter. Remove grease or oil with a solvent, effective alkaline cleaner, or detergent as recommended by water and graffiti-resistant treatment manufacturer.
C. Allow surfaces to dry prior to application.
D. Protect all surrounding areas as recommended by the manufacturer or as directed by the Architect.
    1. Windows: Windows shall be protected from contact with materials by masking with polyethylene or other approved techniques.
    2. All polished stone, metal, or non-masonry surfaces shall be protected from contact with the material by masking with polyethylene.
    3. Masonry surfaces must be in good repair. All new masonry construction surfaces must be allowed to cure for a minimum of 28 days prior to application. Surfaces must be completely dry.
E. Verify all windows, exterior intakes and air conditioning vents are covered and air handling equipment is shut down during application and until vapors have dissipated.

3.02 WATER AND GRAFFITI RESISTANT TREATMENT APPLICATION

A. Test each surface and/or material to be treated to ensure compatibility and desired water and graffiti-resistant treatment results. The surface to be treated must be clean and free of all foreign matter and as dry as possible to ensure proper penetration of water and graffiti-resistant treatment.
B. Do NOT dilute water and graffiti- resistant treatment.
C. Proceed with application of water and graffiti-resistant treatment in an orderly manner once application rate has been tested; work from bottom to top of each scaffold width and from one end of each elevation to the other.
D. Apply water and graffiti-resistant treatment to dry surfaces that comply with manufacturer's written instructions; use brush or spray application methods, at Contractor's option.
E. Preferred method of application is with low pressure, spray equipment. Use roller or brush for small scall applications or when spray applications are not appropriate. Apply in coverage rate as recommended by manufacturer for type of material.
F. Spray Application:
    1. Uniformly saturate water and graffiti-resistant treatment using the “wet-on-wet” application method from bottom up, creating a 6 to 8 inch rundown below the spray contact point. Apply in accordance with manufacturer recommendation.
    2. Let the first application penetrate for 2 to 3 minutes. Brush out heavy runs and drips to prevent build up. Do not spray apply at pressures exceeding 50 psi.
    3. Reapply a second coat of water and graffiti-resistant treatment for heavily textured and porous surfaces.
        a. Apply once first coat is dry to touch, or within [one][two] hour[s] of first coat. Allowing more than [one][two] hour[s] between coats reduces the effectiveness of the second coat.
G. Roller or Brush Application:
    1. Uniformly saturate the surface with water and graffiti-resistant treatment. Avoid excessive overlapping. Brush out heavy runs and drips to prevent build up.
    2. Reapply second coat of water and graffiti-resistant treatment for maximum protection.
        a. Apply once first coat is dry to touch, or within [one][two] hour[s] of first coat. Allowing more than [one][two] hour[s] between coats reduces the effectiveness of the second coat.
H. Vertical Wood Application:
    1. Uniformly saturate the surface with water and graffiti-resistant treatment to the point of rejection.

2. Let the first application penetrate for 2 to 3 minutes.
3. Reapply a second coat of water and graffiti-resistant treatment. Apply once the first coat is dry to touch, or within two hours of the first coat.

3.03 GRAFFITI REMOVER APPLICATION

A. At locations indicated, clean exterior masonry and concrete surfaces to comply with the manufacturer's recommendations designed to dissolve most spray paints, marking pens, and acrylic sealers from masonry.

3.04 PROTECTION

A. Protect adjacent surfaces not scheduled to receive treatment. If applied on unscheduled surfaces, remove immediately, by manufacturer approved method.
B. Protect treated surfaces from rain for at least 6 hours after application.
C. Correct damage by cleaning, as approved by Architect/Engineer.

DIVISION 07 21 00 – THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rigid board insulation at perimeter foundation wall, over roof deck, exterior wall behind metal panel wall finishes.
B. Semi-rigid board insulation at cavity exterior wall construction at face of concrete masonry and behind metal panel wall finishes using cladding support systems.
C. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
D. Batt insulation for filling perimeter window and door shim spaces and expansion joints and similar crevices in exterior walls and roofs.

1.02 RELATED REQUIREMENTS

A. *Division 05 40 00* - Cold-Formed Metal Framing: Board insulation as wall sheathing.
B. *Division 07 27 00* - Air Barriers: Separate air barrier materials.
C. *Division 09 21 16* - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

A. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.
E. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2024.
F. FM DS 1-28 - Wind Design; 2007.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source.

1.06 DELIVERY, STORAGE AND HANDLING

A. Protection: Use means necessary to protect the materials of this section before, during and after installation and to protect the work and materials of other trades.
B. Delivery and Storage: Deliver materials to the job site, and store in a safe, dry location with labels intact and legible.
C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to assure compliance with requirements.

1.07 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to

successful installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermal Insulation Manufacturers:
   1. Johns Manville; www.jm.com/#sle.
   2. Knauf Insulation; www.knaufnorthamerica.com
   3. Atlas Roofing Corporation; www.atlasroofing.com/#sle..
   4. Owens-Corning; www.owenscorning.com.
   5. Rmax Inc; www.rmax.com/#sle.
   6. Rockwool Group; www.rockwool.com.
   7. Approved Equal.
   8. Substitutions: See *01 60 00* - Product Requirements.

2.02 APPLICATIONS

A. Insulation Inside Masonry Cavity Walls: Rain screen / cavity wall continuous semi-rigid insulation: Semi-rigid mineral Wool
B. Insulation behind metal wall panels with cladding support systems: Rain screen / cavity wall continuous semi-rigid insulation: Semi-rigid mineral Wool
C. Insulation behind metal wall panels without cladding support systems: Rain screen / cavity wall continuous high compressive rigid insulation: High-compressive strength mineral wool board
D. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.
E. Insulation Over Roof Deck: Foam board insulation:.Polyisocyanurate board
F. Insulation at Structural Connections and within structural members: Rigid, high-strength polyurethane.

2.03 RAIN SCREEN/CAVITY WALL CONTINUOUS SEMI-RIGID INSULATION

A. Product Basis of Design: Thermafiber® RainBarrier®, semi-rigid mineral wool insulation board that is water-repellent, non-combustible per ASTM E136, and meets ASTM C612 Type IVB:
   1. R-value: 4.3 per inch.
   2. Facing: Unfaced.
   3. Density: 6.0 pcf (nominal).
   4. Moisture-Resistance: Absorption of less than 0.03% by volume when tested in accordance with ASTM C1104.
   5. Surface Burning Characteristics: Tested in accordance with ASTM E84. Unfaced: Flame Spread 0 and Smoke Developed 0.
   6. Fiber Type: EPA Choice fiber; minimum 75% pre-consumer recycled content; complies with EPA Preference Program.
   7. Fiber Type: Standard fiber; 70% pre-consumer recycled content.
   8. Post-Consumer Recycled Content: 0%.
   9. UL® Certified Environmental Product Declaration (EPD) in accordance with ISO 14025
   10. Hardware: RainBarrier® Clip, insulation retaining clip, for securing RainBarrier® continuous insulation to exterior substrate; recommended by manufacturer as compatible with multiple types of masonry and façade tie systems.

2.04 RAIN SCREEN/CAVITY WALL CONTINUOUS HIGH COMPRESSIVE RIGID INSULATION

A. Product Basis of Design: Thermafiber® RainBarrier® ci High Compressive (80), rigid, high-compressive strength board that is water -repellent, non-combustible per ASTM E136, and meets ASTM C 612 Type IVB
   1. R-Value: 4.2 per inch.
   2. Facing: Unfaced.
   3. Compressive Strength: 475 lbs./sq.ft. at 10% compression.
   4. Moisture-Resistance: Absorption of less than 0.05% by volume when tested in accordance with ASTM C1104.
   5. Fiber Type: EPA Choice fiber; minimum 75% pre-consumer recycled content; complies with EPA Preference Program.
   6. Fiber Type: Standard fiber; 70% pre-consumer recycled content.
   7. Post-Consumer Recycled Content: 0%.
   8. UL® Certified Environmental Product Declaration (EPD) in accordance with ISO 14025
   9. Hardware: RainBarrier® Clip, insulation retaining clip, for securing RainBarrier® continuous

insulation to exterior substrate; recommended by manufacturer as compatible with multiple types of masonry and façade tie systems.

10. Hardware: Impasse® Hangers and Impasse® Locking Washers used to secure RainBarrier® continuous insulation directly to Z-Furring channels

2.05 BATT INSULATION MATERIALS

A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.

B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
   4. Formaldehyde Content: Zero.
   5. Thermal Resistance: R-value of 21.
   6. Thickness: 5-1/2 inch.
   7. Facing: Unfaced.
   8. Manufacturers:
      a. Basis of Design: Owens Corning; EcoTouch PINK FIBERGLAS Insulation, PINK NEXT GEN Fiberglas Insulation: www.ocbuildingspec.com/#sle.
      b. CertainTeed Corporation: www.certainteed.com.
      c. Johns Manville: www.jm.com.
      d. Approved Equal.
   9. Substitutions: See 01 6000 - Product Requirements.

C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   3. Facing: Unfaced.
   4. Thermal Resistance: R-value of 21.
   5. Thickness: 5-1/2 inch.
   6. Manufacturers:
      a. Basis of Design: Owens Corning, Thermafiber Fire & Sound Guard Plus FF Formaldehyde-free mineral wool insulation: www.ocbuildingspec.com/#sle.
      b. Basis oJohns Manville: www.jm.com/sle.
      c. ROXUL, Inc; ROXUL AFB: www.roxul.com/#sle.
      d. Approved Equal.
      e. Substitutions: See *01 60 00* - Product Requirements.

2.06 STRUCTURAL THERMAL BREAK

A. Locations: brick support lintel angles.

B. Structural thermal break material to prevent thermal bridging between building elements.
   1. Material: High strength polyurethane or reinforced laminate thermoset.
   2. Thickness: 1/2 inch.
   3. Compressive Strength: 38,000psi minimum.
   4. Manufacturers:
      a. Basis of Design: Armatherm FRR thermal insulation material; www.armatherm.com/#sle.
      b. ClimaSpec LLC: ClimaSpec TB: www.climaspec.com/sle.
      c. Substitutions: See *Division 01 60 00* - Product Requirements.

2.07 ACCESSORIES

A. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
   1. Application: Sealing of interior circular penetrations, such as pipes or cables.
   2. Width: Are required for application.

B. Foam fill and tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.

C. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
D. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
   1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.
E. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.
F. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrates, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.
C. Install boards horizontally on walls.
D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
E. Place 6 inches wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames, and tape seal in place to ensure continuity of vapor retarder and air seal.
F. Tape insulation board joints.
   1. Place membrane surface facing out and tape seal board joints.
G. Coordinate work of this section with construction of air barrier seal specified in *Division 07 27 00*.

3.02 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

3.03 VERIFICATION

A. Upon completion of the installation in each area, visually inspect and verify that insulation is complete and properly installed.

DIVISION 07 27 00 – AIR BARRIERS

PART 1 GENERAL

When requested and applicable, spray applied closed cell polyurethane shall be considered. Designer is to specify a test method for achieving the required thickness. Material shall meet current energy code requirements. Material shall be tested for air permeance per ASTM E2178 and vapor permeance per ASTM E96. Refer to section DIVISION 04 20 00 - MASONRY for information about use as cavity wall insulation. **No spray applied open cell insulation shall be used and highly discouraged**.

1.01 SECTION INCLUDES

A. Air barriers.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.

1.03 DEFINITIONS

A. Air Barrier: Airtight barrier made of material that is virtually air impermeable but water vapor permeable, both to amount as specified, with sealed seams and sealed joints to adjacent surfaces.

1.04 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016.
B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2017.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
E. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on material characteristics, performance criteria, and limitations.

C. Testing Reports: Provide test reports that specified products installed in exterior wall assemblies meet the performance requirements of NFPA 285 as determined by the analysis of NFPA 285 fire test data obtained through the testing conducted in accordance with NFPA 285 and ASTM E1354. Test report is of wall assembly, not individual specified product. Submit all test reports for all wall assemblies at the same time.
   1. If test reports are not available for the indicated wall assemblies, Contractor shall include the cost to obtain a Fire Protection Engineer's Certification of the wall assembly.
D. Shop Drawings: Provide drawings of special joint conditions.
E. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.
F. Manufacturer's qualification statement.
G. Installer's qualification statement.
H. Testing agency qualification statement.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years' documented experience.
B. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture, and use secondary materials approved in writing by primary material manufacturer.
C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.07 MOCK-UPS

A. See *Division 01 40 00* - Quality Requirements for additional requirements.
B. See *Division 01 43 39* - Mockups for additional requirements.
C. Construct air barrier mock-up, 10 feet long by 10 feet wide (100 sq. ft. of wall surface), indicating coating, flexible flashing and transition membrane at intersection of wall air barrier with roof air barrier and with foundation wall intersection, incorporating back-up wall, cladding, window and door frame and sill, insulation, building corner.
D. Test mock-up in accordance with *Division 01 40 00* - Quality Requirements, and in accordance with ASTM E783 and ASTM E1105 for air and water infiltration.
E. Locate where indicated on Architectural Site Plan drawing.
F. Mock-up may remain as part of work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:
   1. Deliver materials to the jobsite in undamaged and clearly marked containers and/or wrapping indicating the name of the manufacturer and product.
B. Storage of Materials:
   1. Store materials as recommended by the manufacturer and conform to applicable safety regulatory agencies. Refer to all applicable data including, but not limited to, Safety Data Sheets, Product Data Sheets, product labels, and specific instructions for personal protection.
   2. Keep solvents away from open flame or excessive heat.
   3. Store rolled materials on end.
C. Handling:
   1. Product requirements may vary. Refer to product specific Safety Data Sheet.

1.09 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

1.10 WARRANTY

A. Manufacturer Material Warranty:
   1. Provide Air Barrier Manufacturer's standard five/ten (5/10) year material warranty.

PART 2 PRODUCTS

2.01 MATERIALS - GENERAL

A. Specified products in this Section used in exterior wall assemblies must be NFPA 285 Compliant Wall Assemblies.

2.02 AIR BARRIER MATERIALS (AIR IMPERMEABLE AND WATER VAPOR PERMEABLE)

A. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
   1. Air Barrier Coating:
      a. Vertical and lateral flame propagation: meets IBC NFPA 285 Exception #2 per ASTM E1354 and ASTM E84.
      b. Material: Silyl-terminated polyether (STPE).
      c. Color: Black.
      d. Dry Film Thickness (DFT): 30 mil, 0.030 inch, minimum.
      e. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
      f. Water Vapor Permeance: 11 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method, at 73.4 degrees F.
      g. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 180 days of weather exposure.
      h. Elongation: 250 percent, minimum, when tested in accordance with ASTM D412.
      i. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
      j. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
      k. VOC Content: <250 g/L..<250 oz/gal
      l. Sealants, Tapes and Accessories: As recommended by coating manufacturer. Products:
         1) Basis of Design: W.R. Meadows, Inc; Air-Shield LMP, Black: www.wrmeadows.com/#sle.
         2) Carlisle Coatings and Waterproofing, Inc; Fire Resists Barritech VP: www.carlisleccw.com/#sle.
         3) Henry Company; Air-Bloc 17MR: www.henry.com/#sle.
         4) Tremco; ExoAIR 230: www.tremcosealants.com.
         5) Approved Equal.
         6) Substitutions: See *01 60 00* - Product Requirements.

1.01 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Air Barrier and Adjacent Substrates: As indicated or in compliance with air barrier manufacturer's installation instructions.
B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement waived if not installed on roof.
   1. Width: 6 inches.
   2. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 180 days of weather exposure.
C. Preformed Transition Membrane: Semirigid silicone or polyester composition, tapered edges, tear resistant.
D. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that surfaces and conditions are ready for work of this section.
B. Where existing conditions are responsibility of another installer, notify Architect/Engineer of unsatisfactory conditions.
C. Do not proceed with this work until unsatisfactory conditions have been corrected.

2.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

2.03 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.
B. Air Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
C. Apply sealants and adhesives within recommended temperature range in accordance with

manufacturer's installation instructions.

D. Fluid-Applied Coatings or Membranes:
   1. Prepare substrate in accordance with manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
   2. Where exterior masonry veneer is being installed, install masonry anchors before installing air barrier over masonry; provide airtight seal around anchors.
   3. Apply bead or trowel coat of mastic sealant with minimum thickness of 1/4 inch along coating seams, rough cuts, and as recommended by manufacturer.
   4. Use flashing to seal to adjacent construction and to bridge joints in coating substrate.

E. Openings and Penetrations in Exterior Air Barriers:
   1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto air barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
   2. At openings with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
   3. At openings with nonflanged frames, seal air barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
   4. At head of openings, install flashing under air barrier extending at least 2 inches beyond face of jambs; seal air barrier to flashing.
   5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
   6. Service and Other Penetrations: Form flashing around penetrating item and seal to air barrier surface.

2.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Owner will provide testing services, and Contractor to provide temporary construction and materials for testing.

C. Coordination of ABAA Tests and Inspections:
   1. Provide testing and inspection required by ABAA QAP.
   2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
   3. Cooperate with ABAA testing agency.
   4. Allow access to air barrier work areas and staging.
   5. Do not cover air barrier work until tested, inspected, and accepted.

D. Do not cover installed air barriers until required inspections have been completed.

E. Obtain approval of installation procedures from air barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.

F. Take digital photographs of each portion of installation prior to covering up air barriers.

2.05 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

DIVISION 07 41 13 – METAL ROOF PANELS

PART 1 GENERAL

Standing seam roofing is the preferred roof system for medium and high-pitched roofs. Batten seam systems shall be used on roofs greater than 4/12 and rolled seam systems shall be used on roofs less than 4/12. Acceptable manufacturers include:

- Metal Sales Corporation
- MBCI
- AEP-SPAN
- McElroy Metal
- Architectural Metal Systems

Other materials and types of metal panel roof systems shall be used only with the special consent and approval of the Owner. Specify ice and water shield at perimeter adjacent to gutters.
WARRANTY: Refer to *DIVISION 01 78 00* - SPECIAL WARRANTIES AND MAINTENANCE AGREEMENTS
Snow Guards: shall be installed at roof eaves. Provide snow guards that attach to the metal roof panel seams.

Snow guards shall not penetrate or be adhered to metal roof panels. Snow guard systems shall have **a**ttachments **t**o catch and/or block ice from the roof panels.
DRAINAGE: Drain all metal panel roof areas into external gutters and downspouts per *DIVISION 07 60 00* - FLASHING AND SHEET METAL. Downspouts shall drain into an underground drainage system.

1.01 SECTION INCLUDES

A. Metal roof panel system of preformed aluminum panels.

1.02 *RELATED REQUIREMENTS*

A. *Division 05 21 00* - Steel Joist Framing: Roof Framing.
B. *Division 05 31 00* - Steel Decking: Roof Framing.
C. *Division 06 10 00* - Rough Carpentry: Roof sheathing.
D. *Division 07 00 00* - Thermal Insulation: Rigid roof insulation.
E. *Division 07 42 13* - Metal Wall Panels: Preformed wall panels.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
C. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; 2005 (Reapproved 2017).
D. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems; 2018.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
    1. Storage and handling requirements and recommendations.
    2. Installation methods.
    3. Specimen warranty.
C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
    1. Show work to be field-fabricated or field-assembled.
D. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.
E. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches square, representing actual roofing metal, thickness, profile, color, and texture.
    1. Include typical panel joint in sample.
    2. Include typical fastening detail.
F. Manufacturer's qualification statement.
G. Installer's qualification statement.
H. Test Reports: Indicate compliance of metal roofing system to specified requirements.
I. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section and with at least three years of documented experience.
    1. Accredited by IAS in accordance with IAS AC472.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.
B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.07 FIELD CONDITIONS

A. Do not install metal roof panels, eave protection membrane, underlayment, or when surface, ambient air, or wind chill temperatures are below 45 degrees F.

1.08 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

C. Special Warranty: Provide 5-year warranty for weathertightness of roofing system, including agreement to repair or replace metal roof panels that fail to keep out water commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Architectural Metal Roof Panel Manufacturers:

1. ATAS International, Inc; 2" Field-Lok: www.atas.com/#sle.
2. Berridge Manufacturing Company; Double-Lock Zee-Lock Panel: www.berridge.com/#sle.
3. MBCI, a Cornerstone Building Brands Company; SuperLok: www.mbci.com/#sle.
4. Petersen Aluminum Corporation; Tite-Loc Plus Panel: www.pac-clad.com/#sle.
5. Approved Equal.
6. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:

1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
3. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F.

2.03 METAL ROOF PANELS

A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

B. Metal Panels: Factory-formed panels with factory-applied finish.

1. Aluminum Panels:
   a. Alloy and Temper: Aluminum complying with ASTM B209/B209M; temper as required for forming.
   b. Thickness: Minimum 20-gauge, 0.032 inch.
2. Profile: Standing seam, with minimum 2-inch seam height; concealed fastener system for field seaming with special tool.
3. Texture: Smooth.
4. Length: Maximum possible length to minimize lapped joints. Where lapped joints are unavoidable, space laps so that each sheet spans over three or more supports.
5. Width: Maximum panel coverage of 16 inches.

2.04 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.05 FABRICATION

A. Panels: Provide factory or field fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.

2.06 FINISHES

A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss as indicated on drawings or as selected

by Architect from manufacturer's standard line.

2.07 DECK SHEATHING AND COVER BOARD

A. Fiberglass Mat Faced Gypsum Roof Board:
   1. Acceptable Product: GP Gypsum, DensDeck® Roof Boards.
   2. Thickness: 1/2 inch.
   3. Size: 4 feet. by 8 feet.
   4. Weight: 2.0 lb/sq. ft.
   5. Surfacing: Fiberglass Mat.
   6. Flexural Strength, Parallel (ASTM C473): 80 lbf, minimum.
   7. Flute Span (ASTM E661): 5 inches.
   8. Permeance (ASTM E96): Greater than 23 perms.
   9. R-Value (ASTM C518): 0.56.
   10. Water Absorption (ASTM C473): Less than 5 percent of weight.
   11. Surface Water Absorption (ASTM C473): Nominal 1.0 grams.
   12. Compressive Strength (Applicable Sections of ASTM C472): Nominal 900 pounds per square inch.
   13. Flame Spread/ Smoke Development (ASTM E84): Not more than 0 Flame Spread, 0 Smoke Development.
   14. Combustibility (ASTM E136): Noncombustible.
   15. Fire resistance rating (UL 790 and ASTM E108): Class A.
   16. Mold Resistance (ASTM D3273): Scored a 10.

2.08 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
   1. Classifications:
      a. Type II:
         1) Compressive Strength: Class 2, Grade 2 - 20 psi, minimum.
   2. Facers: glass-reinforced felt facer.
   3. Board Size: 48 by 96 inches.
   4. Board Thickness: 1.5 inch minimum, installed in 2 layers staggered to achieve continuous R-25.
   5. Board Edges: Square.

2.09 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.
   1. Downspouts: Open face, rectangular profile.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:
   1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
   2. Concealed Sealant: Non-curing butyl sealant or tape sealant.

D. Underlayment: Synthetic non-asphaltic sheet, intended by manufacturer for mechanically fastened roofing underlayment without sealed seams.

E. Underlayment: Basis of Design: Self-Adhering Sheet Membrane Roof Underlayment: Grace Ice and Water Shield HT by GCP Applied Technologies, Inc with the following characteristics:
   1. Material: Cold applied, self-adhering membrane composed of an innovative and proprietary rubberized asphalt adhesive and interwound with a disposable release sheet. An embossed, slip resistant surface is provided on the high-performance film with UV barrier properties.
   2. Membrane Thickness: 40 mils (1.02 mm) per ASTM D3767 Method A.
   3. Membrane Tensile Strength: MD 33 lbf/in, CD 31 lbf/inch per ASTM D412 Die C Modified.
   4. Membrane Elongation: 250% per ASTM D412 Die C Modified.
   5. Low Temperature Flexibility: Unaffected at -20 degrees F (-29 degrees C) per ASTM D1970.

6. Maximum Permeance: 0.05 perms (2.9 ng/sgms Pa) per ASTM E96.
7. Maximum Material Weight Installed: 0.22 pounds/sqft (1.1 kg/sqm) per ASTM D461.
8. Service Temperature: 260 degrees F (115.6 degrees C) per ASTM D1204
9. Compatibility: Suitable for use under all types of sloped roofing with the exception high altitude climates where zinc, copper or Cor-Ten roof coverings are used.
10. Adhesive: Rubberized asphalt adhesive containing post-consumer recycled content, contains no calcium carbonate, sand or fly ash.
11. Exposure: Can be left exposed for a maximum of 120 days from date of installation per ASTM G90 – EMMAqua test.
12. Primer: as recommended by underlayment manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Broom clean sheathing prior to installation of roofing system.
B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.
C. Remove protective film from surface of roof panels immediately prior to installation; strip film carefully to avoid damage to prefinished surfaces.
D. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturers.
E. Protect surrounding areas and adjacent surfaces from damage during execution of this work.
F. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.
   1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
   2. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.
B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.
C. Install roof underlayment and roof sheathing before installing preformed metal roof panels; secure by methods acceptable to roof panel manufacturer, minimizing use of metal fasteners; apply from eaves to ridge in shingle fashion, overlapping horizontal joints at least 2 inches and side and end laps at least 3 inches; offset seams in building paper and seams in roofing felt.
D. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.
   1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by panel manufacturer.
   2. Provide concealed clips at panel joints, and apply snap-on battens to provide weathertight joints.
   3. Provide sealant tape or other approved joint sealer at lapped panel joints.
   4. Install sealant or sealant tape at end laps and side joints as recommended by metal roof panel manufacturer.
   5. Mechanically seam panels in accordance with metal roof panel manufacturer.

3.04 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and

unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

DIVISION 07 42 13 – METAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured metal panels for exterior wall panels, with related flashings and accessory components.

1.02 RELATED REQUIREMENTS

A. *Division 05 40 00* - Cold-Formed Metal Framing: Wall panel substrate.

B. *Division 07 00 00* - Thermal Insulation.

C. *Division 07 27 00* - Air Barriers: Air barrier under wall panels.

D. *Division 07 42 13* - Cladding Support System.

E. *Division 07 92 00* - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

C. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.

B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:

1. Physical characteristics of components shown on shop drawings.
2. Storage and handling requirements and recommendations.
3. Installation instructions and recommendations.

C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.

D. Samples: Submit two samples of wall panel, 12 inches by 12 inches in size illustrating finish color, sheen, and texture.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in installing products specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.

C. Prevent contact with materials that may cause discoloration or staining of products.

1.07 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Wall Panels - Concealed Fasteners:
   1. Basis of Design: Morin Corp; Matrix Series: www.morincorp.com/#sle.
   2. ATAS International, Inc.; www.atas.com/#sle.
   3. Berridge Manufacturing Company; www.berridge.com/#sle.
   4. Centria; www.centria.com/#sle,
   5. Approved Equal.
   6. Substitutions: See *01 60 00* - Product Requirements.

B. Metal Wall Panel Schedule:
   1. EMP-1: Basis of Design: Morin Corp; Matrix Series MX-8; Orientation: Vertical; Color: Weathered Zinc
   2. EMP-2: Basis of Design: Morin Corp; Matrix Series MX-1; Orientation: Vertical; Color: Weathered Zinc
   3. EMP-4: Basis of Design: Morin Corp; Classic Series FS-12-0; Orientation: Vertical; Color: Weathered Zinc
   4. EMP-3: Basis of Design: Morin Corp; Matrix Series MX-1; Orientation: Horizontal; Color: Weathgered Zinc.

C. Metals;
   1. EMTL-1: Basis of Design: Morin Corp flat sheet; Color: Match BRK-1.
   2. EMTL-2: Basis of Design: Morin Corp flat sheet; Color: Match BRK-2.
   3. EMTL-3: Basis of Design: Morin Corp flat sheet; Color: Match BRK-3.
   4. EMTL-4: Basis of Design: Morin Corp flat sheet; Color: Weathered Zinc.
   5. EMTL-5: Basis of Design: Morin Corp flat sheet; Color: Weathered Zinc.
   6. EMTL-6: Basis of Design: Morin Corp flat sheet; Color: Champagne Bronze.
   7. EMTL-7: Basis of Design: Morin Corp flat sheet; Color: Match Metal Roof Panels MR-1.

2.02 METAL WALL PANEL SYSTEM

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
   1. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
   2. Design Pressure: In accordance with applicable codes.
   3. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
   4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
   5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
   6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
   7. Corners: Factory-fabricated in one continuous piece with minimum 2-inch returns.

B. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

C. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

D. Anchors: Aluminum or Stainless steel.

2.03 MATERIALS

A. Precoated Aluminum Sheet: 040-inch thickness; ASTM B209/B209M, 3105 alloy, O temper, with smooth surface texture; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.04 FINISHES

A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss as selected by Architect from manufacturer's standard line.
   1. Products:

a. Arkema, Inc; Kynar 500: www.arkema.com/#sle.
b. PPG; Duranar: www.ppgmetalcoatings.com/#sle.
c. Sherwin-Williams Company; Fluropon: www.coil.sherwin.com/#sle.
d. Approved Equal.
e. Substitutions: See *01 60 00* - Product Requirements.

2.05 ACCESSORIES

A. Support for Cladding and Continuous Insulation: Continuous thermal Z-girts.
1. Fiberglass reinforced plastic (FRP) girts that provide cladding attachment support for metal wall panels.
2. Depth: As indicated on drawings. As required for thickness of insulation, 2" minimum thickness of insulation,
3. Length: 6 inches for clips and 96 inches for girts.
4. Spacing: 16 inches on center, vertically or as indicated by manufacturer for design loads.
5. Fasteners: As recommended by manufacturer.

B. Sub-girts: .040" aluminum hat or zee shaped panel support framing attached to cladding support system, thru high-density board insulation, CMU or sheathed wall as indicated on drawings.
C. Concealed Sealants: Non-curing butyl sealant or tape sealant, see *Division 07 92 00*
D. Field Touch-up Paint: As recommended by panel manufacturer.
E. Bituminous Paint: Asphalt base.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building framing members are ready to receive panels.
B. Verify air barrier, see *Division 07 27 00*, has been installed over wall panel substrate; see *Division 05 40 00*.

3.02 PREPARATION

A. Install sub girts perpendicular to panel length, securely fastened to substrate or cladding support system and shimmed and leveled to uniform plane, and spaced at intervals indicated or as recommended by metal panel manufacturer.
B. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.03 INSTALLATION

A. Install panels on walls in accordance with manufacturer's instructions.
B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint; allow to dry prior to wall panel installation.
C. Fasten panels to structural supports; aligned, level, and plumb.
D. Locate joints over supports.
E. Lap panel ends 2 inches, minimum.
F. Use concealed fasteners unless otherwise indicated by Architect/Engineer.
G. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.04 TOLERANCES

A. Offset From True Alignment Between Adjacent Members Abutting or In Line: 1/16 inch, maximum.
B. Variation from Plane or Location As Indicated on Drawings: 1/4 inch, maximum.

3.05 CLEANING

A. Remove site cuttings from finish surfaces.
B. Remove protective material from wall panel surfaces.
C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

3.06 PROTECTION

A. Protect metal wall panels until completion of project.
B. Touch-up, repair, or replace damaged wall panels or accessories before Date of Substantial Completion.

DIVISION 07 42 13.23 – METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior cladding consisting of formed metal composite material (MCM) sheet, secondary supports, and anchors to structure, attached to solid backup.

B. Matching flashing and trim.

1.02 RELATED REQUIREMENTS

A. *Division 07 05 43* - Cladding Support Systems.
B. *Division 07 42 13* - Metal Wall Panels: Color.
C. *Division 07 62 00* - Sheet Metal Flashing and Trim: Metal flashing components integrated with this wall system.

1.03 REFERENCE STANDARDS

A. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2017.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
C. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2023.
D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
G. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2021).
H. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2023.
I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
J. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
K. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
M. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, coordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
    1. Require attendance by the installer and relevant sub-contractors.
    2. Include MCM sheet manufacturer’s representative and wall system manufacturer’s representative to review storage and handling procedures.
    3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
    4. Review procedures for protection of work and other construction.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
    1. Finish manufacturer's data sheet showing physical and performance characteristics.
    2. Storage and handling requirements and recommendations.
    3. Fabrication instructions and recommendations.
    4. Specimen warranty for finish, as specified herein.
C. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
    1. Physical characteristics of components shown on shop drawings.
    2. Storage and handling requirements and recommendations.
    3. Installation instructions and recommendations.

4. Specimen warranty for wall system, as specified herein.

D. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, support clips, exposed fasteners, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Indicate panel numbering system.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the wall system must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.
   5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.
   6. Include design engineer's stamp or seal on shop drawings for attachments and anchors.

E. Verification Samples: For each finish product specified, submit at least three samples, minimum size 12-inch square, and representing actual product in color and texture.

F. Design Data: Submit structural calculations stamped by design engineer, for Architect/Engineer's information and project record.

G. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.

H. Test Report: Submit test report verifying compliance with NFPA 285 for previously tested exterior wall assembly.

I. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.

J. Manufacturer's qualification statement.

K. Installer's qualification statement.

L. Testing agency's qualification statement.

M. Maintenance Data: Care of finishes and warranty requirements.

N. Testing Reports: Provided test reports that specified products installed in exterior wall assemblies meet the performance requirements of NFPA 285 as determined by the analysis of NFPA 285 fire test data obtained through the testing conducted in accordance with NFPA 285 and ASTM E1354. Test report is of wall assembly, not individual specified product. Submit all test reports for all wall assemblies at the same time.
   1. If test reports are not available for the indicated wall assemblies, Contractor shall include the cost to obtain a Fire Protection Engineer’s Certification of the wall assembly.

1.06 QUALITY ASSURANCE

A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.

B. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing wall panel systems specified in this section.
   1. With not less than three years of documented experience.

D. Installer Qualifications: Company specializing in performing work of the type specified in this section.
   1. With minimum three years of documented experience.
   2. Approved by wall panel system manufacturer.

E. Testing Agency Qualifications: Independent agency experienced in testing assemblies of the type required for this project and having the necessary facilities for full-size mock-up testing of the type specified.

1.07 MOCK-UPS

A. See *Division 01 40 00* - Quality Requirements for additional requirements.

B. Provide a mock-up for evaluation of fabrication workmanship for diagonal grid pattern.

C. Locate where directed.

D. Provide specified finish on panels.

E. Mock-up may remain as part of work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification

labels intact.

1. Protect finishes by applying heavy-duty removable plastic film during production.
2. Package for protection against transportation damage.
3. Provide markings to identify components consistently with drawings.
4. Exercise care in unloading, storing, and installing panels to prevent bending, warping, twisting, and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1. Store in well-ventilated space out of direct sunlight.
2. Protect from moisture and condensation with tarpaulins or other suitable weathertight covering installed to provide ventilation.
3. Store at a slope to ensure positive drainage of accumulated water.
4. Do not store in enclosed space where ambient temperature can exceed 120 degrees F.
5. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.09 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals for additional warranty requirements.

B. Correct defective work within a five-year period after Date of Substantial Completion, including defects in water tightness and integrity of seals for insulated metal wall panel systems.

C. Correct defective work within a five-year period after Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.

D. Installation Warranty for Building Rainscreen Assembly: Installer of exterior rainscreen assembly (including air/vapor barrier and attachments, framing, and exterior panels) to provide 10-year warranty that includes coverage for defective materials and/or workmanship. This warranty will also clearly include materials, labor, necessary activity to access these areas, and removal of any materials to effect repairs and restore them to watertight conditions; www.edacontractors.com/#sle.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Composite Material (MCM) Sheet Manufacturers:

1. Basis of Design: ALUCOBOND USA; ALUCOBOND PLUS: www.alucobondusa.com/#sle.
2. Alpolic /fr; Mitsubishi Chemical America, inc. ALPOLIC Division; www.alpolic-americas.com/#sle
3. Reynobond FR Aluminum Composite Material; Arconic Architectural Products; www.arconic.com/#she
4. Lumabuilt A1000: www.lumabuilt.com/#sle
5. Approved Equal.
6. See *01 60 00* - Product Requirements.

B. Wall Panel System Manufacturers:

1. Basis of Design: Petersen Aluminum Corporation; PAC-3000 RS: www.pac-clad.com/#sle.
2. Citadel Architectural Products, Inc; Envelope 2000 Rainscreen (RS) System: www.citadelap.com/#sle.
3. DAMS Incorporated; CCRS Series: www.damsinc.com/#sle.
4. East Coast Metal Systems, Inc; EC-200 Rainscreen System with larson by Alucoil: www.ecmsinc.net/#sle.
5. Approved Equal.
6. See *01 60 00* - Product Requirements.

2.02 WALL PANEL SYSTEM

A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage, or failure.

1. Provide structural design by or under direct supervision of a Structural Engineer licensed in the State in which the Project is located.
2. Provide panel jointing and weatherseal using reveal joints and gaskets but no sealant.
3. Anchor panels to supporting framing without exposed fasteners.

2.03 PERFORMANCE REQUIREMENTS

A. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F to 180 degrees F without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
   1. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:
   2. Inward Design Wind Pressure: +20 psf.
   3. Outward Design Wind Pressure: -24 psf.
   4. Maximum deflection of perimeter framing member of L/175 normal to plane of the wall; maximum deflection of individual panels of L/60.
   5. Maximum anchor deflection in any direction of 1/16 inch at connection points of framing members to anchors.

B. Air Leakage: 0.10 cfm/sq ft maximum leakage when tested at 1.57 psf pressure difference in accordance with ASTM E283/E283M.

C. Water Penetration: No water penetration under static pressure when tested in accordance with ASTM E331 at a differential of 10 percent of inward acting design load, 6.27 psf minimum, after 15 minutes.
   1. Water penetration is defined as the appearance of uncontrolled water on the interior face of the wall.
   2. Design to drain leakage and condensation to the exterior face of the wall.

D. Fire Performance: Tested in accordance with, and complying with acceptance criteria of NFPA 285.

2.04 PANELS

A. Panels: 1-inch-deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
   1. Reinforce corners with riveted aluminum angles.
   2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
   3. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
   4. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
   5. Metallic Finished Panels: Maintain consistent grain of MCM sheet; specifically, do not rotate sheet purely to avoid waste.
   6. Fabricate panels under controlled shop conditions.
   7. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
   8. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
      a. Make panel lines, breaks, curves, and angles sharp and true.
      b. Keep plane surfaces free from warp or buckle.
      c. Keep panel surfaces free of scratches or marks caused during fabrication.
   9. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.
   10. For "dry" jointing, secure extrusions to returned pan edges with stainless steel rivets; provide means of concealed drainage with baffles and weeps for water that might accumulate in members of system.

2.05 MATERIALS

A. Metal Composite Material (MCM) Sheet: Two sheets of aluminum sandwiching a core of extruded thermoplastic material; no foamed insulation material content.
   1. Overall Sheet Thickness: 0.157-inch, minimum.
   2. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in

bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.

3. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
4. Flammability: Self-ignition temperature of 650 degrees F or greater when tested in accordance with ASTM D1929.

B. Metal Framing Members: Include sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
1. Provide material strength, dimensions, configuration as required to meet the applied loads applied and in compliance with applicable building code.
2. Sheet Steel Components: ASTM A653/A653M galvanized to G90/Z275 or zinc-iron alloy-coated to A60/ZF180; or ASTM A792/A792M aluminum-zinc coated to AZ60/AZM180.
3. Stainless Steel Sheet Components: ASTM A480/A480M.
4. Aluminum Components: ASTM B209/B209M; or ASTM B221 (ASTM B221M).

2.06 FINISHES

A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, with at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mils, 0.0009 inch; color and gloss as selected by Architect from manufacturer’s standard line.
1. Manufacturers:
a. PPG Metal Coatings; Duranar: www.ppgmetalcoatings.com/#sle.

B. Color/Texture: Match Morin Champagne Bronze; or As selected by Architect/Engineer from manufacturer's custom range.

2.07 ACCESSORIES

A. Flashing: Sheet aluminum; 0.040 inch thick, minimum; finish and color to match MCM sheet; see Section 07 6200 for additional requirements.

B. Fasteners:
1. Exposed Fasteners: Stainless steel; permitted only where absolutely unavoidable and subject to prior approval of the Architect/Engineer.
2. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
3. Bolts: Stainless steel.
4. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.

C. Provide panel system manufacturer's and installer’s standard corrosion resistant accessories, including fasteners, clips, anchorage devices, and attachments.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine dimensions, tolerances, and interfaces with other work.

B. Examine substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer's written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before proceeding.

D. Notify Architect/Engineer in writing of conditions detrimental to proper and timely completion of work, and do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

3.03 INSTALLATION

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.

B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.

C. Install wall system securely allowing for necessary thermal and structural movement; comply with

wall system manufacturer's instructions for installation of concealed fasteners.

D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.
E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect/Engineer; comply with MCM sheet manufacturer's instructions and recommendations for field forming.
F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.
G. Where joints are designed for field-applied sealant, seal joints completely with specified sealant.
H. Install flashings as indicated on shop drawings. At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.
I. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
    1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
    2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
    3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
    4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.
J. Replace damaged products.

3.04 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements for additional requirements.
B. Wall System Manufacturer's Field Services: Provide field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with instructions.

3.05 CLEANING

A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.
B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.
C. Remove temporary coverings and protection of adjacent work areas.
D. Clean installed products in accordance with manufacturer's instructions.

3.06 PROTECTION

A. Protect installed panel system from damage until Date of Substantial Completion.

DIVISION 07 42 93 – SOFFIT PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush-profile, concealed fastener, lap-seam metal soffit panels with related metal trim and accessories.

1.02 RELATED REQUIREMENTS

A. *Division 05 Section "Structural Steel Framing"* for steel framing supporting metal panels.
B. *Division 05 Section "Cold-Formed Metal Framing"* for cold-formed metal framing supporting metal panels.
C. *Division 07 Section "Thermal Insulation"* for thermal insulation installed under metal panels.
D. *Division 07 Section "Air Barriers"* for air barriers within metal panel assembly and adjacent to metal panel assembly.
E. *Division 07 Section "Sheet Metal Flashing and Trim"* for sheet metal flashing items in addition to items specified in this Section.

1.03 REFERENCES

A. American Architectural Manufacturer's Association (AAMA): www.aamanet.org:
    1. AAMA 621 - Voluntary Specifications for High-Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates.
    2. AAMA 809.2 Voluntary Specification Non-Drying Sealants.

B. American Society of Civil Engineers (ASCE): www.asce.org/codes-standards:
   1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
C. ASTM International (ASTM): www.astm.org:
   1. ASTM A755 - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
   2. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
   3. ASTM C920 - Specification for Elastomeric Joint Sealants.
   4. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
   5. ASTM D4214 - Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
   6. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
D. International Accreditation Service (IAS):
   1. IAS AC472 Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems, Part B.

1.04 QUALITY ASSURANCE

A. Manufacturer/Source: Provide metal panel assemblies and accessories from a single manufacturer accredited under IAS AC472, Part B.
B. Installer Qualifications: Experienced Installer certified by metal panel manufacturer with minimum of five (5) years' experience with successfully completed projects of a similar nature and scope.
   1. Installer's Field Supervisor: Experienced mechanic certified by metal panel manufacturer supervising work on site whenever work is underway.
C. Steel Construction Publications: Comply with published recommendations in the following, unless more stringent requirements are indicated.
   1. American Institute of Steel Construction (AISC): "Steel Construction Manual."
   2. American Iron and Steel Institute (AISI): "Cold Formed Steel Design Manual."

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Prior to erection of framing, conduct preinstallation meeting at site attended by Owner, Architect, metal panel installer, metal panel manufacturer's technical representative, inspection agency and related trade contractors.
   1. Coordinate building framing in relation to metal panel system.
   2. Coordinate openings and penetrations of metal panel system.
   3. Coordinate work of *Division 07* Sections "Roof Specialties" and "Roof Accessories" and openings and penetrations and manufacturer's accessories with installation of metal panels.

1.06 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets for specified products. Include data indicating compliance with performance requirements.
B. Shop Drawings: Show layouts of metal panels. Include details of each condition of installation, panel profiles, and attachment to building. Provide details at a minimum scale 1-1/2-inch per foot of edge conditions, joints, fastener and sealant placement, flashings, openings, penetrations, and special details. Make distinctions between factory and field assembled work.
   1. Indicate points of supporting structure that must coordinate with metal panel system installation.
   2. Include structural data indicating compliance with performance requirements and requirements of local authorities having jurisdiction.
C. Samples for Initial Selection: For each exposed product specified including sealants. Provide representative color charts of manufacturer's full range of colors.
D. Samples for Verification: Provide 12-inch- (305 mm-) long section of each metal panel profile. Provide color chip verifying color selection.

1.07 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Indicating compliance of products with requirements.
B. Qualification Information: For Installer firm and Installer's field supervisor.
C. IAS Accreditation Certificate: Indicating that manufacturer is accredited under provisions of IAS

AC472 Part B.

D. Manufacturer's warranty: Unexecuted sample copy of manufacturer's warranty.

1.08 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Manufacturer's Warranty: Executed copy of manufacturer's warranty.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect products of metal panel system during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage. Protect panels and trim bundles during shipping.

1. Deliver, unload, store, and erect metal panels and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.
2. Store in accordance with Manufacturer's written instruction. Provide wood collars for stacking and handling in the field.
3. Shield foam insulated metal panels from direct sunlight until installation

1.10 WARRANTY

A. Special Manufacturer's Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace metal panel assemblies that fail in materials and workmanship within 20 years from date of Substantial Completion.

B. Special Panel Finish Warranty: On Manufacturer's standard form, in which Manufacturer agrees to repair or replace metal panels that evidence deterioration of factory-applied finish within the warranty period, as follows:

1. Fluoropolymer Two-Coat System:
   a. Color fading in excess of 5 Hunter units per ASTM D2244.
   b. Chalking in excess of No. 8 rating per ASTM D4214.
   c. Failure of adhesion, peeling, checking, or cracking.
   d. Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Basis of Design: Morin, a Kingspan Group Company; www.morincorp.com.

B. MBCI Metal Roof and Wall Systems, Division of NCI Group, Inc.; www.mbci.com.

C. Approved Equal.

D. Substitutions: See *01 60 00* - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. General: Provide metal panel system meeting performance requirements as determined by application of specified tests by a qualified testing facility on manufacturer's standard assemblies.

B. Structural Performance: Provide metal panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated, as determined by ASTM E1592:

1. Wind Loads: Determine loads based on uniform pressure, importance factor, exposure category, and basic wind speed indicated on drawings.
   a. Wind Negative Pressure: Certify capacity of metal panels by actual testing of proposed assembly.
2. Deflection Limits: Withstand inward and outward wind-load design pressures in accordance with applicable building code with maximum deflection of 1/120 of the span with no evidence of failure.
3. Seismic Performance: Comply with ASCE 7 Sections 9, "Earthquake Loads."

C. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction. Allow for deflection and design for thermal stresses caused by temperature differences from one side of the panel to the other.

2.03 FORMED METAL SOFFIT PANELS

A. Flush-Profile, Concealed Fastener Metal [Soffit] [and] [Liner] Panels: Metal panels consisting of formed metal sheet with vertical panel edges, with flush joints between panels, field assembled with nested lapped edges, and attached to supports using concealed fasteners.

1. Basis of Design: Morin, PS-12 flush panel and PSV-12 flush vented panel.

2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, structural quality, Grade 50.
    a. Nominal Thickness: 24 gage coated thickness, with smooth surface.
        1) Exterior Finish: Fluoropolymer two-coat system.
        2) Color: To match Sherwin Williams 7669 Summit Gray.
        3) Panel Width: 12 inches.
        4) Panel Thickness: 1 inch.

2.04 MISCELLANEOUS MATERIALS

A. General: Provide complete metal panel assemblies incorporating trim, fasciae, and miscellaneous flashings. Provide required fasteners, closure strips, and sealants as indicated in manufacturer's written instructions.
B. Flashing and Trim: Match material, thickness, and finish of metal panels.
C. Fasteners: Self-tapping screws and other acceptable fasteners recommended by metal panel manufacturer. Where exposed fasteners cannot be avoided, supply corrosion-resistant fasteners with heads matching color of metal panels by means of factory-applied coating, with weathertight resilient washers.

2.05 FABRICATION

A. General: Provide factory fabricated and finished metal panels, trim, and accessories meeting performance requirements, indicated profiles, and structural requirements.
B. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions, approved shop drawings, and project drawings.

2.06 FINISHES

A. Finishes, General: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
B. Fluoropolymer Two-Coat System: 0.2 - 0.3 mil primer with 0.7 - 0.8 mil 70 percent PVDF fluoropolymer color coat, AAMA 621.
    1. Color: Morin Weathered Zinc.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine metal panel system substrate with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of metal panels.
    1. Inspect framing that will support metal soffit panels to determine if support components are installed as indicated on approved shop drawings and are within tolerances acceptable to metal panel manufacturers and installer. Confirm presence of acceptable framing members at recommended spacing to match installation requirements of metal panels.
B. Correct out-of-tolerance work and other deficient conditions prior to proceeding with insulated metal panel installation.

3.02 METAL PANEL INSTALLATION

A. Concealed-Fastener Formed Metal Soffit Panels: Install metal panel system in accordance with manufacturer's written instructions, approved shop drawings, project drawings, and referenced publications. Install metal panels in orientation, sizes, and locations indicated. Anchor panels and other components securely in place. Provide for thermal and structural movement.
B. Fasten metal panels to supports with fasteners at each location indicated on approved shop drawings, at spacing and with fasteners recommended by manufacturer. Fasten panel to support structure through leading panel flange. Fit back flange of subsequent panel into secured flange of previous panel.
    1. Cut panels in field where required using manufacturer's recommended methods.
    2. Dissimilar Materials: Where elements of metal panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by metal panel manufacturers.
C. Attach panel flashing trim pieces to supports using recommended fasteners.

3.03 ACCESSORY INSTALLATION

A. General: Install metal panel accessories with positive anchorage to building and weather tight mounting; provide for thermal expansion. Coordinate installation with flashings and other components.
    1. Install components required for a complete metal panel assembly, including trim, flashings, sealants, closure strips, and similar items.

2. Comply with details of assemblies utilized to establish compliance with performance requirements and manufacturer's written installation instructions.
3. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently weather resistant.

3.04 CLEANING AND PROTECTION

A. Clean finished surfaces as recommended by metal panel manufacturer.
B. Replace damaged panels and accessories that cannot be repaired to Architect's satisfaction.

DIVISION 07 43 00 - FIBERGLASS SHINGLE ROOFING

When required by project type, asphalt shingle roofing weighing 300 pounds per square or greater are acceptable for use on medium pitched roofs. Shingles Roofing must meet an R30 value (minimum) for a complete functioning system. Blown insulation is acceptable to obtain the R30 value at the shingles. MSCS requires the implementation of mildew resistant properties for the specified shingles. Fiberglass asphalt shingles shall be used as required by existing design criteria or written approval by the Director of Major Construction. Maintain existing slope. Shingles shall be self-sealing; no staples. Mandatory substrate protection is a waterproof underlayment membrane, i.e. ice and water shield. For budgetary constraints, specify minimum #30 felt underlayment. MSCS discourages the use of nail guns and will only be considered on a case-by-case basis. Shingles roofing must meet a minimum of R30 value for a complete functioning system.

DIVISION 07 50 00 - MEMBRANE ROOFING

PART 1 GENERAL

Slopes shall be accomplished primarily by sloping the supporting structure. Slope to 1/4" per foot in all directions. Small areas and crickets may be accommodated using tapered insulation.
New roofs shall not slope to a parapet wall with scuppers through the wall (unless required for design aesthetics matching existing and only if approved by MSCS DoMC PM). Avoid roof drains in the field of the roof unless the configuration of the building makes sloping the roof to the edges impractical. The preferred collection system is gutters along the low edges of the roof. Gutters and Downspouts to be designed per *DIVISION 07 60 00 - FLASHING AND SHEET METAL*.
All low slope roof areas shall be accessible by means of a roof scuttle/hatch, exterior door, or exterior roof ladders.

1.01 DESCRIPTION

A. The contractor shall furnish all labor and materials and perform all work required for the installation of a 60 mil., R-30, Fully Adhered Non-Reinforced Single-Ply EPDM (Ethylene Propylene Diene Terpolymer) Membrane or a Modified Bitumen Roofing system including but not limited to:
   1. Roofing manufacturer's requirements for the specified warranty.
   2. Preparation of roofing substrates.
   3. Wood nailers for roofing attachment.
   4. Perimeter Edge & Penetration Air Barrier
   5. Rigid Insulation.
   6. Single-Ply EPDM Membrane or Mod-Bit Membrane Roof System
   7. Roof terminations and expansion joints.
   8. Roof Edge Flashing / Metal and drainage.
   9. Walkway pads.
   10. Other roofing-related items specified or indicated on the drawings or otherwise necessary to provide a complete weatherproof roofing system.

B. Disposal of demolition debris and construction waste is the responsibility of Contractor. Perform disposal in manner complying with all applicable federal, state, and local regulations.
C. Comply with the published recommendations and instructions of the roofing membrane manufacturer.
D. Commencement of work by the Contractor shall constitute acknowledgement by the Contractor that this specification can be satisfactorily executed, under the project conditions and with all necessary prerequisites for warranty acceptance by roofing membrane manufacturer. Any modification of the Contract Sum will be made in accordance with the stipulations of the Contract

Documents stated elsewhere.

1.02 SECTION INCLUDES

A. Adhered system with membrane roofing.
B. Insulation, flat and tapered.
C. Vapor retarder.
D. Deck sheathing.
E. Coverboards.
F. Flashings.
G. Roofing stack boots, roofing expansion joints, and walkway pads.

1.03 RELATED REQUIREMENTS

A. *Division 05 31 00* - Steel Decking: Product requirements for acoustical insulation for deck flutes, for placement by this section.
B. *Division 06 10 00* - Rough Carpentry: Wood nailers and curbs.
C. *Division 07 62 00* - Sheet Metal Flashing and Trim: Counterflashings, reglets.
D. *Division 07 72 00* – Roof Accessories
E. *Division 07 72 33* – Roof Hatch
F. *Division 22 10 06* - Plumbing Piping Specialties: Roof drains.

1.04 REFERENCE STANDARDS

A. ANSI/ SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roof Systems".
B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
C. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.
D. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
F. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
G. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board; 2017.
H. ASTM C728 - Standard Specification for Perlite Thermal Insulation Board; 2017a (Reapproved 2022).
I. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
J. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.
K. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).
L. ASTM D312 – Asphalt Used in Roofing
M. ASTM D2178 – Asphalt Impregnated Glass (Felt) used in roofing & waterproofing
N. ASTM D3273 – Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
O. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 1983 (Reapproved 2018).
P. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2008.
Q. ASTM D4811 – Standard Specification for Nonvulcanized (Uncured) Rubber Sheet Used as Roof Flashing; 2004.
R. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
S. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
T. ASTM E136 – Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.
U. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2011 (Reapproved 2019).
V. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
W. FM DS 1-28 – Design Wind Loads; Factory Mutual System; 2007.

X. FM DS 1-29 – Roof Deck Securement & Above Deck Components; Factory Mutual System; 2006
Y. FM 4470 – Approval Standard – Class I Roof Covers; current edition
Z. ITS (DIR) - Directory of Listed Products; current edition.
AA. NRCA (RM) - The NRCA Roofing Manual; 2024.
BB. NRCA (WM) - The NRCA Waterproofing Manual; 2005.
CC. PS 1 – Construction and Industrial Plywood; 2009
DD. PS 20 – American Softwood Lumber Standard; 2010
EE. SPRI RP-4 - Wind Design Standard for Ballasted Single-Ply Roofing Systems; 2022.
FF. UL (DIR) - Online Certifications Directory; Current Edition.
GG. UL (FRD) - Fire Resistance Directory; current edition.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.
   1. Review preparation and installation procedures and coordinating and scheduling required with related work.
   2. The roofing contractor shall be fully knowledgeable of all requirements of the contract documents and shall make themselves aware of all job site conditions that will affect their work.
   3. Roofing contractors must accept deck substrate and drainage conditions as acceptable prior to beginning roof work. It is the contractor's responsibility to make all necessary corrections to the deck before beginning work as recommended for the required warranty and to meet FM I-90 uplift requirements.

1.06 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, fasteners, etc.
C. Shop Drawings: Submit drawings that indicate joint or termination detail conditions and conditions of interface with other materials and walkway pads; the roof membrane manufacturer's standard details customized for the specified project for all relevant conditions, including flashings, base tie-ins, roof edges, terminations, expansion joints, penetrations, and drains.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. Provide certifications from the proposed manufacturer showing that (1) the contractor can provide the manufacturer's twenty-year warranty and (2) the foreman for this project is trained by the manufacturer in the application of the proposed roofing system.
E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
F. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
G. Sustainable Design Documentation: Test report showing solar reflectance index of membrane.
H. Specimen Warranty: 20-year NDL, 5-year labor.
I. Warranty Documentation:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   2. Submit installer's certification that installation complies with warranty conditions for waterproof membrane.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section with at least five years of documented experience, specializing in performing the work of this section by system manufacturer to provide 20-year no dollar limit guarantee.
C. ***100% Commissioning by a certified, third-party commissioning agent.***

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact. Deliver in sufficient quantity to permit work to continue without interruption.
B. Store materials in weather protected environment (between 60°F and 80°F), clear of ground, and

moisture.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight. Insulation and underlayment products must be on pallets, off the ground and tightly covered with 6 mil. poly and tarps to provide waterproof enclosure. Manufacturer's wrap does not provide sufficient waterproofing. Insulation and underlayment products that become wet or saturated are to be discarded.

1.09 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

D. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

E. If discrepancies are discovered between the existing conditions and those noted on the drawings, immediately notify the owner's representative by phone and solicit the manufacturer's approval prior to commencing with the work. Necessary steps shall be taken to make the building watertight until the discrepancies are resolved.

1.10 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals, for additional warranty requirements.

B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.

1. Warranty Term: Membrane manufacturer's 20 years No Dollar Limit, full system plus Installer's 5-year Labor Warranty.
2. For repair and replacement include costs of both material and labor in warranty.
3. Exceptions are not Permitted:
   - Damage due to roof traffic.
   - Damage due to wind speed greater than 56 mph but less than 120 mph.
4. All sheet metal, flashing, trim, counterflashing, parapet caps, and similar items covered by or listed in the specifications or otherwise shown in the contract documents must be covered by the roof system manufacturer's 20-year warranty.

No "early bird" warranties will be accepted. Roof warranties shall commence upon substantial completion of project. MSCS requires that all roofing contractors be certified and in good standing with the manufacturer of the product being installed. MSCS requires that the contractor provide at a minimum a manufacturer's 20-year, no dollar limit, fully system warranty as well as a 5-year contractor labor warranty. These are warranties issued by the manufacturer prior to the roof being inspected by the manufacturer based on the reputation and experience of the roofer. If a condition of the manufacturer issuing a warranty is that the manufacturer will inspect and approve the roof installation, then require a copy of the inspection report (and any follow-up inspections after corrections are made) and approval as part of the closeout documents along with the warranty. Require some sort of confirmation that the warranty fee has been paid before the warranty form is issued. Issuance of the warranty should be made dependent on the manufacturer's acknowledgment that all conditions have been met for the warranty to be valid.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. SINGLE PLY MEMBRANE ROOFING: Shall be nominal 60-mil, fully adhered non-reinforced black EPDM (Ethylene Propylene Diene Terpolymer) sheet membrane. Membrane shall comply with ASTM D 4637, Type I or II as applicable, and shall be labeled as such. Designers must confirm energy code criteria in reference to reflectance of the roofing system prior to specifying color. The complete roofing system including membrane, insulation, and attachments shall meet requirements of FMI-60 and Class 1A and UL Class A. Acceptable manufacturers include:

- Carlisle
- Versico
- Firestone/Elevate
- Gen-Flex

- Johns Manville

B. MODIFIED BITUMEN ROOFING: Shall be hot asphalt mopped type with a minimum of two plies and shall have a factory applied granular surface. Modifiers and reinforcements shall be as recommended by the Design Consultant; however, no organic products shall be specified. Acceptable manufacturers include:

- Johns Manville
- Siplast
- Tremco
- Soprema
- Firestone

FLASHING: Base flashing shall be type recommended by membrane manufacturer.
INSULATION & COVER BOARD: Same manufacturer as roof membrane. Able to provide polyisocyanurate insulation that is produced in own facilities.
METAL ROOF EDGING: Same manufacturer as roof membrane.

2.02 ROOFING SYSTEM

A. Roofing System:

1. Membrane: Ethylene propylene diene monomer (EPDM).
2. Thickness: As specified elsewhere.
3. Membrane Attachment: Fully adhered.
4. Slope: Deck is sloped but not enough; provide additional slope of 1/4 inch per foot (1:48) by means of tapered insulation.
5. Comply with applicable local building code requirements.
6. Provide assembly having Underwriters Laboratories, Inc. (UL) Class A Fire Hazard Classification.
7. Provide assembly complying with Factory Mutual Corporation (FM) Roof Assembly Classification, FM DS 1-28 and 1-29, and meeting minimum requirements of FM 1-90 wind uplift rating.

B. Roofing Materials:

1. Roofing and Flashing Membrane: Black cured synthetic single-ply membrane composed of ethylene propylene diene terpolymer (EPDM) with the following properties:
   . Thickness: 0.060 inch (1.5 mm).
   a. Reinforcement: Polyester weft inserted scrim; membrane complying with ASTM D 4637 Type II.
   b. Nominal Thickness Tolerance: Plus/minus 10 percent.
   c. Sheet Width: Provide the widest available sheets to minimize field seaming.
   d. Acceptable Product: RubberGard Non-Reinforced EPDM Membrane by manufacturer.
2. Membrane Fasteners: Type and size as required by roof membrane manufacturer for roofing system and warranty to be provided; use only fasteners furnished by roof membrane manufacturer.
3. Flashing Membrane: Self-curing, non-reinforced membrane composed of nonvulcanized EPDM rubber, complying with ASTM D 4811 Type II, and with the following properties:
   a. Thickness: 0.055 inch (1.4 mm).
   b. Color: Same as field membrane
   c. Acceptable Product: RubberGard EPDM FormFlash™.
4. Self-Adhesive Flashing Membrane: Semi-cured 45 mil EPDM membrane laminated to 35 mil (0.9 mm) EPDM tape adhesive; QuickSeam™ Flashing.
5. Pre-Molded Pipe Flashings: EPDM, molded for quick adaptation to different sized pipes; EPDM Pipe Flashing.
6. Self-Adhesive Lap Splice Tape: 35 mil (0.9 mm) EPDM-based, formulated for compatibility with EPDM membrane and high-solids primer.
7. Splice Adhesive: Synthetic polymer-based, formulated for compatibility with EPDM membrane and metal surfaces.
8. Bonding Adhesive: Neoprene-based, formulated for compatibility with EPDM membrane and wide variety of substrate materials, including masonry, wood, and insulation facings.
9. Adhesive Primer: Synthetic rubber-based primer formulated for compatibility with EPDM membrane and tape adhesive, with VOC content less than 2.1 lb/gal (250 g/L).

10. Low Rise Foam Adhesive: Two-component, low-rise polyurethane adhesive designed to attach polyisocyanurate insulation to a variety of acceptable substrates.
11. Seam Edge Treatment: EPDM rubber-based sealant, formulated for sealing exposed edges of membrane at seams.
12. Pourable Sealer: Two-part polyurethane, two-color for reliable mixing.
13. Water Block Seal: Butyl rubber sealant for use between two surfaces, not exposed.
14. Metal Plates and Strips Used for Fastening Membrane and Insulation: Steel with Galvalume coating; corrosion-resistance meeting FM 4470 criteria.
    a. Termination Bars: Aluminum bars with integral caulk ledge; 1.3 inches (33 mm) wide by 0.10 inch (2.5 mm) thick.
15. Roof Walkway Pads: EPDM, 0.30 inch (7.6 mm) thick by 30 by 30 inches (760 by 760 mm) with EPDM tape adhesive strips laminated to the bottom.

2.03. PERIMETER EDGE & PENETRATION AIR BARIER:

A. Air & Vapor Barrier: A 40-mil composite consisting of 35-mils of self-adhering rubberized asphalt factory laminated to a 5-mil polyethylene film with an adhesion textured surface. Product is applied after cleaning, drying and priming an acceptable substrate with manufacture's approved primer.
B. Install high-density closed-cell polyurethane foam or filler insulation pieces to support the edge stripping.

2.04. PROTECTION TOP SHEET

A. Sacrificial Top Sheet: Rubbergard Neoprene Membrane or like kind self-curing material for protection layer over EPDM roofing systems from rooftop contaminants (i.e., grease, animal fats).

2.05. INSULATION

A. Insulation shall be ISO 95+™ GL / ISOGARD GL polyiso board insulation by Elevate as supplied by Manufacturer. Minimum R-value required is R-30 for total base insulation for flat areas and R-30 for sloped roofs. (Note: The insulation must meet ASHRAE 90.1 minimums per IBC-International Building Code.)
    1. Polyisocyanurate – A foam core insulation board covered on both sides with a medium weight fiber-reinforced felt facer meeting ASTM C 1289-06, Type II, Class 1, Grade 3 (20 psi). Use 4x4 sheets for adhered systems and 4x8 for mechanically attached systems. Minimum R-value of 5.7 per 1" layer.
    2. Insulation shall be installed in multiple layers. The layers of insulation shall be mechanically fastened or adhered to the substrate in accordance with the manufacturer's published specifications and drawings. Stagger joints in adjacent layers with 12" stagger in all directions at all board joints. No joints shall align throughout the system.
B. Tapered Insulation: Install fully-adhered 1/4" (1/8" where indicated) tapered insulation package as identified in Part 1 of this specification per Building as supplied by Manufacturer.
C. Crickets and Edge Strips: Shop fabricated to provide proper drainage/ taper/ crickets indicated. Comply with requirements of ASTM C 1289.

2.06. METAL ACCESSORIES

A. Metal Roof Edging and Fascia: Continuous metal edge member serving as termination of roof membrane and retainer for metal fascia; watertight with no exposed fasteners; mounted to roof edge nailer.
    1. Wind Performance:
        a. Membrane Pull-Off Resistance: 100 lbs/ft (1460 N/m), minimum, when tested in accordance with ANSI/SPRI ES-1 Test Method RE-1, current edition.
        b. Fascia Pull-Off Resistance: At least the minimum required when tested in accordance with ANSI/SPRI ES-1 Test Method RE-2, current edition.
        c. Provide product listed in current Factory Mutual Research Corporation Approval Guide with at least FM 1-270 rating.
    2. Description: Two-piece; 45 degree sloped galvanized steel sheet edge member securing top and bottom edges of formed metal fascia.
    3. Fascia Face Height: refer to construction drawings.
    4. Edge Member Height Above Nailer: see drawings.
    5. Fascia Material and Finish: 24 gage, 0.024 inch (0.06 mm) galvanized steel with Kynar 500

finish in manufacturer's standard color; matching concealed joint splice plates; factory-installed protective plastic film.

6. Length: 144 inches (3650 mm).
7. Functional Characteristics: Fascia retainer supports while allowing for free thermal cycling of fascia.
8. Aluminum Bar: Continuous 6063-T6 alloy aluminum extrusion with pre-punched slotted holes; miters welded; injection molded EPDM splices to allow thermal expansion.
9. Anchor Bar Cleat: 20 gage, 0.036-inch (0.9 mm) G90 coated commercial type galvanized steel with pre-punched holes.
10. Fasteners: Factory-provided corrosion resistant fasteners, with drivers; no exposed fasteners permitted.
11. Special Shaped Components: Provide factory-fabricated pieces necessary for complete installation, including miters, scuppers, and end caps; minimum 14 inch (355 mm) long legs on corner pieces.
12. Scuppers: Welded watertight.
13. Accessories: Provide matching brick wall cap, downspout, extenders, and other special fabrications as shown on the drawings.

2.07. ACCESSORY MATERIALS

A. Wood Nailers: PS 20-dimension lumber, Structural Grade No. 2 or better Southern Pine, Douglas Fir; or PS 1, APA Exterior Grade plywood; pressure preservative treated.
   1. Width: 3-1/2 inches (90 mm), nominal minimum, or as wide as the nailing flange of the roof accessory to be attached to it.
   2. Thickness: Same as thickness of roof insulation.

B. Pre-Molded Pipe Flashing: EDPM, molded for quick adaptation to different sized pipes; EPDM Pipe Flashing.

C. Membrane Flashing and cover strips: 60-mil non-reinforced roll flashing as recommended by membrane manufacturer.

D. Pre-Molded Accessories: Inside corners, outside corners, T-joint covers, curb wrap corners, pipe flashings, sealant pockets, pipe seals, etc. as recommended by membrane manufacturer.

E. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

F. Sheathing Adhesive: Noncombustible type, for adhering gypsum sheathing to metal deck.

G. Sheathing Joint Tape: Paper type, self-adhering.

H. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self-adhering.

I. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
   1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.
   2. Fastener pullout resistance: 300lb (136.1 Kg).

J. Primers and Membrane Adhesive: As recommended by membrane manufacturer.

K. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

L. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.

M. Insulation Adhesive: As recommended by insulation manufacturer.

N. Roofing Nails: Galvanized, hot-dipped type, size and configuration as required to suit application.

O. Strip Reglet Devices: Galvanized steel, maximum possible lengths per location, with attachment flanges.

P. Termination Bar: -inch wide and 1/8-inch thick extruded aluminum bar pre-punched 6” on center with sealant ledge.

Q. Sealants: As recommended by membrane manufacturer.
   1. Size: 18 by 18 inches.
   2. Surface Color: black
   3. Location: surround all access points (ladders, hatches, doorways) and extend to all rooftop air-handling equipment.
   4. Installation: Heat weld or fully adhere to roof membrane in accordance with manufacturer’s recommendations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.
B. Verify deck is supported and secure.
C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
D. Verify deck surfaces are dry and free of snow or ice.
E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips and cant strips are in place.

3.02 PREPARATION - CONCRETE DECK

A. Fill surface honeycomb and variations with latex filler.
B. Do not begin work until elevated concrete substrate has cured at least 28 days and moisture content is five percent or less.
    1. Test as Follows:
        a. Concrete Moisture Content: No beading water under plastic after 16 hours when tested in accordance with ASTM D4263.
        b. Relative Humidity in Concrete: Not greater than 75 percent when tested in accordance with ASTM F2170.

3.03 PREPARATION - METAL DECK

A. Install preformed sound absorbing glass fiber insulation strips supplied by Section 05 31 00 in acoustic deck flutes where indicated. Install in accordance with manufacturer's instructions.
B. Install deck sheathing/substrate board on metal deck:
    1. At acoustical metal decks, fill flutes with fiberglass acoustical insulation.
    2. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
    3. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
    4. Tape joints.
    5. At acoustical metal decks, adhere deck sheathing to steel deck, with adhesive applied in accordance with manufacturer’s instructions for uplift.
    6. At all other steel decks, mechanically fasten sheathing to roof deck, in accordance with Factory Mutual recommendations and roofing manufacturer's instructions.

3.04 INSTALLATION, GENERAL

A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
B. Do not apply roofing membrane during cold or wet weather conditions.
C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
F. Wood Nailers: Install salt preservative pressure treated wood nailers or engineered blocking systems in locations indicated on drawings or as required by field conditions.
    1. Secure nailers to deck surface in accordance with FM Loss Prevention Data Bulletin 1-49 for spacing and sizing of fasteners based on project wind zone.
    2. Minimum nailer size is 2x6 (1-1/2-inch x 5-1/2 inch).
    3. Width of the nailers must exceed width of the metal flange of edgings, scuppers, etc.
G. Coordinate this work with installation of associated sheet metal and counterflashings installed by other sections as the work of this section proceeds.

3.05 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

A. Install vapor retarder to concrete or deck sheathing surface with adhesive in accordance with manufacturer's instructions.
    1. Extend vapor retarder under blocking to deck edge.
    2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.

C. Attachment of Insulation: (adhere all layers above acoustical metal decks)
   1. Mechanically fasten or adhere first layer of insulation to deck in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
   2. Mechanically fasten or adhere second layer of insulation in accordance with roofing and insulation manufacturers' instructions.
   3. Mechanically fasten or adhere tapered insulation in accordance with roofing and insulation manufacturers' instructions.
   4. Increase fastening density at perimeter and corners based on project wind speed and uplift.
D. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.
E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
F. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
G. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
H. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 24 inches.
I. Do not install more insulation than can be covered with membrane in same day.

3.06 INSTALLATION - MEMBRANE

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
B. Shingle joints on sloped substrate in direction of drainage.
C. Fully Adhered Application: Install adhesive to substrate at rate of manufacturer's recommended gal/sq ft. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal or heat weld to make seams permanently waterproof. Probe all heat welded seams after welds have cooled. Install uniform bead of sealant to joint edge.
E. At intersections with vertical surfaces:
   1. Extend membrane up a minimum of 4 inches onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.
   3. Secure flashing to nailing strips at 6 inches on center or as recommended by membrane manufacturer for ES-1 compliance.
   4. Insert flashing into reglets and secure.
F. Around roof penetrations, seal flanges and flashings with flexible flashing.
G. Install roofing expansion joints where indicated. Make joints watertight.
   1. Install prefabricated joint components in accordance with manufacturer's instructions.
H. Coordinate installation of roof drains and sumps and related flashings.

3.07 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for general requirements for field quality control and inspection.
B. Require site attendance of roofing and insulation material manufacturers daily during installation of the work.
C. Install walkway pads or rolls in 10-foot maximum lengths. Space walkway materials 1-inch apart or as recommended by manufacturers to permit drainage. Cut walkway materials at all valley valleys.

3.08 CLEANING

A. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
B. Repair or replace defaced or damaged finishes caused by work of this section.

3.09 PROTECTION

A. Protect installed roofing and flashings from construction operations.
B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

DIVISION 07 60 00 - FLASHING AND SHEET METAL

PART 1 GENERAL

Materials and details used for roof edges, gutters and downspouts shall protect against galvanic action, be permanent and require low maintenance. Details shall be in accordance with the NRCA Roofing Manual and the Architectural Sheet Metal Manual by SMACNA. Edge metal shall be included in full system roofing warranty per *DIVISION 01 78 00 - SPECIAL WARRANTIES AND MAINTENANCE AGREEMENTS*.

Exposed fasteners or gasket screws are permitted.
Install perimeter gutters and downspouts where roofs discharge at eaves. Built-in gutters and downspouts shall not be used. Scuppers shall not be used for primary discharge. When scuppers are used due to architectural condition, scuppers shall have a collection head and built in overflows.

All gutters shall be sized as required by the current adopted code. MSCS prefers a minimum 6" box type hung with gutter brackets. Gutters shall be of continuous lengths of 30-foot with expansions at every 60-foot. Gutters small be designed per SMANCA 5th Edition pages 1.1 through 1.7. Gutter mounting shall be designed per SMACNA 5th Edition page 1.31 figure 1-12.
All downspouts shall be minimum 5" x 6" and properly sized to allow proper water relief. All downspouts to have strainers. Downspouts are preferred to connect to underground storm drainage system with protection at grade as follows: heavy-duty covers (22 gauge minimum) or schedule 10 steel or powder coated stainless steel between finished grade and two feet (2'-0") minimum above finished grade. Covers or pipes shall be painted to match adjacent surface. Provide clean-out flush with finish grade within 10' of building wall or downspout location at all underground storm drainage lines.

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and exterior penetrations.
B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

A. *Division 07 42 13* - Metal Wall Panels: Colors.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
E. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) requirements and standard details, except as otherwise indicated.
B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sheet Metal Flashing and Trim:
   1. Basis of Design: Petersen Aluminum Corporation; www.pac-clad.com/#sle.
   2. Hickman Edge Systems: www.hickmanedgesystems.com/#sle.
   3. Taylor Metal Products: www.taylormetal.com/#sle.
   4. Approved Equal.
   5. Substitutions: See *01 60 00* - Product Requirements.

2.02 SHEET MATERIALS

A. Pre-Finished Aluminum: ASTM B209/B209M; 18-gauge, 0.040 inch thick; plain finish shop pre-coated with PVDF coating.
   1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; pretreated metal with two-coat system including primer and color coat with at least 70 percent PVDF coating. Custom match coating with mica chip or where indicated to match MCM-1.
   2. Color: As selected by Architect/Engineer from manufacturer's standard and custom colors to match adjacent materials.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
B. Form pieces in longest possible lengths.
C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
E. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
F. Fabricate flashings to allow toe to extend 2 inches over roofing underlayment. Return and brake edges.

2.04 GUTTERS AND DOWNSPOUTS

A. Gutters: SMACNA (ASMM) Rectangular profile.
B. Downspouts: Rectangular profile.
C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).
D. Accessories: Profiled to suit gutters and downspouts.
   1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
   2. Gutter Supports: Brackets.
   3. Downspout Supports: Brackets.
E. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3,000 psi at 28 days, with minimum 5 percent air entrainment.
F. Seal metal joints.

2.05 EXTERIOR PENETRATION FLASHING PANELS

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.06 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.
B. Primer Type: Zinc chromate.
C. Concealed Sealants: Non-curing butyl sealant.
D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
E. Fenestration Perimeter Flashing Attachments: Two-piece flashing receiver and clip of extruded aluminum, at least 0.045 inch thick, for attaching flashing at perimeter of exterior wall fenestration openings.
   1. Provide flashing receiver profile appropriate for flashing applications.
F. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

D. Exterior Flashing Receivers: Install in accordance with manufacturer's recommendations, and in proper relationship with adjacent construction.

E. Seal metal joints watertight.

F. Secure gutters and downspouts in place with concealed fasteners.

G. Slope gutters 1/4 inch per 10 feet, minimum.

H. Set splash pads under downspouts.

3.04 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

DIVISION 07 71 00 – ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured roof specialties, including copings, fascias, and gravel stops.

1.02 RELATED REQUIREMENTS

A. *Division 07 72 00* - Roof Accessories: Manufactured curbs, roof hatches, and snow guards.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.

B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.

C. NRCA (RM) - The NRCA Roofing Manual; 2024.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.

D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Roof Edge Flashings and Copings:

1. Basis of Design: ATAS International, Inc; www.atas.com/#sle.
2. Metal-Era Inc: www.metalera.com/#sle.
3. Architectural Products Co; www.archprod.com/#sle.
4. Metal Roofing Systems, Inc: www.metalroofingsystems.biz/#sle.
5. Hickman Edge Systems; www.Hickmanedgesystems.com
6. Approved Equal.

7. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 COMPONENTS

A. Roof Edge Flashings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
   1. Configuration: Fascia, cant, and edge securement for roof membrane.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
   3. Exposed Face Height: As indicated on drawings.
   4. Material: Formed aluminum sheet, 0.063 inch thick, minimum.
   5. Finish: 70 percent polyvinylidene fluoride.
   6. Color: As indicated on drawings.

B. Copings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
   1. Configuration: Concealed hold down cleat at both legs; internal splice piece at joints of same material, thickness, and finish as cap; concealed stainless steel fasteners.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
   3. Wall Width: As indicated on drawings.
   4. Outside Face Height: As indicated on drawings.
   5. Inside Face Height: As indicated on drawings.
   6. Material: Formed aluminum sheet, 0.063 inch thick, minimum.
   7. Finish: 70 percent polyvinylidene fluoride.
   8. Color: As indicated on drawings.

2.03 FINISHES

A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

2.04 ACCESSORIES

A. Sealant for Joints in Linear Components: As recommended by component manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.
   1. See *Division 07 72 00* for information on roofing-related accessories.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
B. Seal joints within components when required by component manufacturer.
C. Anchor components securely.
D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

DIVISION 07 72 00 – ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Curbs.
B. Equipment rails.
C. Roof penetrations mounting curbs.
D. Roof hatches, manual and automatic operation, including smoke vents.
E. Roof walkways and platforms.
F. Non-penetrating pedestals.

1.02 RELATED REQUIREMENTS

A. *Division 05 31 00* - Steel Decking.
B. *Division 07 62 00* - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
D. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2023.
E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
G. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used.
    1. Preparation instructions and recommendations.
    2. Storage and handling requirements and recommendations.
    3. Installation methods.
    4. Maintenance requirements.
C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
    1. Non-penetrating Rooftop Supports: Submit design calculations for loadings and spacings.
    2. Submit shop drawings sealed and signed by a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
D. Warranty Documentation:
    1. Submit manufacturer warranty.
    2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
    3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store products under cover and elevated above grade.

1.06 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a five-year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ROOF CURBS

A. Manufacturers:
    1. AES Industries Inc.: www.aescurb.com.
    2. The Pate Company: www.patecurbs.com.
    3. LM Curbs: www.lmcurbs.com/#sle.
    4. Roof Products & Systems (RPS): www.rpscurbs.com.
    5. Approved Equal.
    6. Substitutions: See *01 60 00* - Product Requirements.
B. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
    1. Applications: Roof curbs used for roof penetrations/openings as indicated on drawings.
    2. Roof Curb Mounting Substrate: Curb substrate consists of flat roof deck sheathing with insulation and TPO Membrane Roofing.
    3. Galvanized Steel: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G60 coating designation; 18-gauge, 0.048 inch thick.

4. Galvalume Steel: Hot-dip aluminum zinc alloy coated steel sheet complying with ASTM A792/A792M; AZ55 coating designation; 18-gauge, 0.048 inch thick.
5. Fabricate curb bottom and mounting flanges for installation directly on metal roof panel system to match slope and configuration of system.
6. Provide layouts and configurations indicated on drawings.

C. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
1. Provide preservative treated wood nailers along top of curb.
2. Insulate inside curbs with 1-1/2-inch thick, anti-microbial, 3 lb density fiberglass insulation.
3. Height Above Finished Roof Surface: 8 inches, minimum.
4. Height Above Roof Deck: 18 inches, minimum.

D. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.
1. Provide preservative treated wood nailers along top of rails.
2. Height Above Finished Roof Surface: 8 inches, minimum.
3. Height Above Roof Deck: 14 inches, minimum.

E. Pipe, Duct, or Conduit Mounting Curbs: Vertical posts, minimum 8 inches square unless otherwise indicated.
1. Provide sliding channel welded along top edge with adjustable height steel bracket, fabricated to fit item supported.
2. Provide preservative treated wood nailers over entire top surface, for supports that are provided by others.
3. Height Above Finished Roof Surface: 8 inches, minimum.
4. Height Above Roof Deck: 14 inches, minimum.

2.02 ROOF HATCHES, MANUAL OPERATION

A. Manufacturers:
1. Babcock-Davis: www.babcockdavis.com.
2. Bilco Company: www.bilco.com/sle.
3. Milcor, Inc: www.milcorinc.com.
4. Nystrom, Inc: www.nystrom.com/#sle.
5. Approved Equal.
6. Substitutions: See *01 60 00* - Product Requirements.

B. Roof Hatches, General: Factory-assembled thermally broken steel frame and cover, complete with operating and release hardware.
1. Style: Provide flat metal covers unless otherwise indicated.
2. Mounting: Provide frames and curbs suitable for mounting conditions as indicated on drawings.
3. For Ladder Access: Single leaf; 30 by 36 inches.
4. For Ships Ladder Access: Single leaf; 30 by 54 inches.
5. For Stair Access: Single leaf; 30 by 96 inches.
6. For Equipment Access: Double leaf; 48 by 48 inches.
7. Material: Mill finished aluminum, 11-gauge, 0.0907 inch thick.
8. Curb Height: 8 inches from finished surface of roof, minimum.

C. Metal Covers: Flush, insulated, hollow metal construction.
1. Capable of supporting 40 psf live load.
2. Material: Mill finished aluminum; outer cover 11-gauge, 0.0907 inch thick, liner 0.04 inch thick.
3. Insulation: Manufacturer's thermally broken, 3-inch polyisocyanurate.
4. Gasket: EPDM, continuous around cover perimeter.

D. Safety Railing System: Roof hatch manufacturer's standard accessory safety rail system mounted directly to curb at any hatch locations within 10 feet of roof edge.
1. Posts and Rails: Aluminum tubing.
2. Gate: Same material as railing; automatic closing with latch.
3. Finish: Manufacturer's standard, factory applied finish.
4. Gate Hinges and Post Guides: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper aluminum.

5. Mounting Brackets: Hot dipped galvanized steel, 1/4 inch thick, minimum.
6. Fasteners: Stainless steel, Type 316.

2.03 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
   1. Design Loadings and Configurations: As required by applicable codes.
   2. Height: Provide minimum clearance of 6 inches under supported items to top of roofing.
   3. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   4. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
   5. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.
   6. Manufacturers:
      a. Metal Roof Innovations, Ltd. S-5! Attachment Solutions: www.s-5.com/#sle.
      b. PHP Systems/Design: www.phpsd.com/#sle.
      c. Portals Plus: www.portalsplus.com/#sle.
      d. Approved Equal.
      e. Substitutions: See *01 60 00* - Product Requirements.

B. Roof Walkways, Stairs, and Crossover Platforms: Non-penetrating, mechanically attached walkway system.
   1. Manufacturers:
      a. Lapeyre Stair; www.lapeyrestair.com.
      b. Precision Ladders; www.precisionladders.com.
      c. Erectastep; www.erectastep.com.
      d. Approved Equal/
      e. See *01 60 00* - Product Requirements.
   2. Dimensions: 36 inch wide treads and platform with minimum 36 inch long platforms over building expansion joints and roof steps. Total length as required. Field verify and coordinate with roofing manufacturer recommendations.
   3. Materials: Carbon Steel, galvanized or Aluminum.
   4. Finish: Galvanized steel. Mill finished Aluminum.
   5. Walking Surfaces and Stair Treads: 18 gauge, 0.0478 inch hot dip galvanized steel grating at G90 in accordance with ASTM A653/A653M, either formed plank grating or welded bar grating, with anti-skid surface. 11 inch minimum tread depth.
   6. Handrails: compliant with IBC– 36-inch high handrail with intermediate rail. At stringers and platforms 30-inches or more above roof surface, provide 42-inch high guardrail and intermediate rail with separate handrail with post brackets located at 36-inch above walking surface and leading edge of treads.
   7. Other: 24-inch square concrete pavers loose laid over roof walkway surfacing material at all stringer bases and post locations.

C. Pipe Supports: Provide attachment fixtures complying with MSS SP-58 and as indicated.
   1. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
   2. See relevant piping system specification section for additional requirements.

D. Duct Supports: Provide attachment fixtures complying with MSS SP-58 and as indicated.
   1. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
   2. See relevant duct system specification section for additional requirements.

E. Conduit and Cable Tray Supports: Provide attachment fixtures complying with MSS SP-58 and as indicated.
   1. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
   2. See relevant conduit and cable tray system specification section for additional requirements.

F. Non-Penetrating Pedestals: Steel pedestals with square, round, or rectangular bases.
   1. Bases: High density polypropylene.
   2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
   4. Manufacturers:
      a. Portals Plus; Pedestal Plus: www.portalsplus.com.
      b. Approved Equal.
      c. Substitutions: See *Division 01 60 00* - Product Requirements

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

A. Clean installed work to like-new condition.

3.05 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

DIVISION 07 81 00 – APPLIED FIRE PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Applied Sprayed Fire Resistive Material (SFRM) section of interior structural steel not exposed to damage or moisture.
B. Applied fire protection of structural steel exposed to damage or moisture.
C. Preparation of applied fire protection for application of exposed overcoat finish specified elsewhere.

1.02 RELATED REQUIREMENTS

A. *Division 07 81 23* - Intumescent Fire Protection.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
B. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members; 2019 (Reapproved 2023).
C. ASTM E759/E759M - Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).
D. ASTM E760/E760M - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).
E. ASTM E859/E859M - Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members; 2023.
F. ASTM E937/E937M - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 1993 (Reapproved 2023).
G. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with placement of ceiling hanger tabs, mechanical component hangers, and electrical components.

B. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittals procedures.
B. Product Data: Provide data indicating product characteristics.
C. Manufacturer's Certificate: Certify that applied fireproofing products meet or exceed requirements of Contract Documents.
D. Test Reports: Reports from reputable independent testing agencies for proposed products, indicating compliance with specified criteria, conducted under conditions similar to those on project, as follows:
    1. Bond strength.
    2. Bond impact.
    3. Compressive strength.
    4. Fire tests using substrate materials similar those on project.
    5. Current UL Design numbers proposed for use with SFRM manufacturer listed
E. Manufacturer's Installation Instructions: Indicate special procedures.
F. Field Quality Control Submittals: Submit field test report.
G. Manufacturer Reports: Indicate environmental conditions that applied fireproofing materials were installed.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience

1.07 MOCK-UP

A. Construct mock-up, approximately 100 square feet or more in size.
B. Comply with project requirements for fire ratings.
C. Locate on beams, joists, and deck in northwest corner of Administration Building where indicated on drawings.
D. Examine installation within one hour of application to determine variances from specified requirements due to shrinkage, temperature, and humidity.
E. Where shrinkage and cracking are evident, adjust mixture and method of application as necessary; remove materials and re-construct mock-up.
F. Mock-up may remain as part of the Work.

1.08 FIELD CONDITIONS

A. Do not apply fireproofing when temperature of substrate material and surrounding air is below 40 degrees F or when temperature is predicted to be below said temperature for 24 hours after application.
B. Provide ventilation in areas to receive fireproofing during application and 24 hours afterward, to dry applied material.
C. Provide temporary enclosure to prevent spray from contaminating air.
D. Do not allow roof traffic during installation of roof fireproofing and drying period.

1.09 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a five-year period after Date of Substantial Completion.
    1. Include coverage for fireproofing to remain free from cracking, checking, dusting, flaking, spalling, separation, and blistering.
    2. Reinstall or repair failures that occur within warranty period.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Applied Sprayed Fire Protection:
    1. Carboline Company: www.carboline.com.
    2. GCP Applied Technologies: www.gcpat.com/#sle.
    3. Isolatek International Corp: www.isolatek.com/#sle.
    4. Approved Equal.
    5. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 APPLIED SPRAYED FIRE PROTECTION ASSEMBLIES

A. Provide assemblies at locations indicated on drawings.
B. At areas indicated on drawings, provide UL fire-rated assemblies to hourly ratings as follows:
   1. Interior roof beams and girders: 1 hour.
   2. Interior floor beams and girders: 2 hours.
   3. Interior floors decks: 2 hours.
   4. Interior roof deck: 1 hour.

2.03 MATERIALS

A. Applied Fire Protection Material for Interior Applications, Concealed: Manufacturer's standard factory mixed material, which when combined with water is capable of providing indicated fire resistance, and complying with following requirements:
   1. Composition: Gypsum-based; not mineral-fiber-based.
   2. Bond Strength: 150 pounds per square foot, minimum, when tested in accordance with ASTM E736/E736M when set and dry.
   3. Dry Density: As required by fire resistance design.
   4. Compressive Strength: 8.33 pounds per square inch, minimum.
   5. Effect of Impact on Bonding: No cracking, spalling or delamination, when tested in accordance with ASTM E760/E760M.
   6. Corrosivity: No evidence of corrosion, when tested in accordance with ASTM E937/E937M.
   7. Air Erosion Resistance: Weight loss of 0.025 g/sq ft, maximum, when tested in accordance with ASTM E859/E859M after 24 hours.
   8. Surface Burning Characteristics: Maximum flame spread index of 0 (zero) and maximum smoke developed index of 0 (zero), when tested in accordance with ASTM E84.
   9. Effect of Deflection: No cracking, spalling, or delamination, when tested in accordance with ASTM E759/E759M.
   10. Fungal Resistance: No growth after 28 days when tested according to ASTM G21.
   11. Manufacturers:
      a. GCP Applied Technologies; Monokote MK-6: www.gcpat.com/#sle.
      b. Approved Equal.
      c. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Applied Sprayed Fire Protection Material Exposed to Damage or Moisture: Manufacturer's standard factory mixed material, which when combined with water is capable of providing indicated fire resistance, and complying with following requirements:
   1. Recommended by manufacturer for permanent exterior exposure.
   2. Composition: Portland cement-based; not mineral fiber-based.
   3. Bond Strength: 1,000 psf, minimum, when tested in accordance with ASTM E736/E736M when set and dry.
   4. Dry Density: As required by fire resistance design.
   5. Compressive Strength: 100 psi, minimum.
   6. Effect of Impact on Bonding: No cracking, spalling or delamination, when tested in accordance with ASTM E760/E760M.
   7. Corrosivity: No evidence of corrosion, when tested in accordance with ASTM E937/E937M.
   8. Air Erosion Resistance: Weight loss of 0.025 g/sq ft, maximum, when tested in accordance with ASTM E859/E859M after 24 hours.
   9. Surface Burning Characteristics: Maximum flame spread index of 0 (zero) and maximum smoke developed index of 0 (zero), when tested in accordance with ASTM E84.
   10. Fungal Resistance: No growth after 28 days when tested according to ASTM G21.
   11. Manufacturers:
      a. GCP Applied Technologies; Monokote Z-106/HY: www.gcpat.com/#sle.
      b. Approved Equal.
      c. Substitutions: See *Division 01 60 00* - Product Requirements.

2.04 ACCESSORIES

A. Primer Adhesive: Of type recommended by applied fire protection manufacturer.
B. Overcoat: As recommended by manufacturer of applied fire protection material.
C. Metal Lath: Expanded metal lath; minimum weight of 1.7 psf, galvanized finish.
D. Water: Clean, potable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive fireproofing.
B. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.
C. Verify that ducts, piping, equipment, or other items that would interfere with application of fireproofing have not been installed.
D. Verify that voids and cracks in substrate have been filled.
E. Verify that projections have been removed where fireproofing will be exposed to view as a finish material.

3.02 PREPARATION

A. Perform tests as recommended by fireproofing manufacturer in applications where adhesion of fireproofing to substrate is in question.
B. Remove incompatible materials that could effect bond by scraping, brushing, scrubbing, or sandblasting.
C. Prepare substrates to receive fireproofing in strict accordance with instructions of fireproofing manufacturer.
D. Apply fireproofing manufacturer's recommended bonding agent on primed steel.
E. Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.
F. Close off and seal duct work in areas where fireproofing is being applied.

3.03 APPLICATION

A. Install metal lath over structural members as indicated or as required by UL Assembly Design Numbers.
B. Apply primer adhesive in accordance with manufacturer's instructions.
C. Apply fireproofing in uniform thickness and density as necessary to achieve required ratings.
D. In exposed locations, trowel surface smooth and form square edges, using tools and procedures recommended by fireproofing manufacturer.
E. Apply overcoat at the rate recommended by fireproofing manufacturer.

3.04 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01 4000 - Quality Requirements.
B. Inspect installed fireproofing after application and curing for integrity, prior to its concealment.
    1. Submit field test reports promptly to Contractor and Architect/Engineer.
C. Ensure that actual thicknesses, densities, and bond strengths meet requirements for specified ratings and requirements of authorities having jurisdiction (AHJ).
D. Repair or replace applied fireproofing at locations where test results indicate fireproofing does not meet specified requirements.
E. Re-inspect installed fireproofing for integrity of fire protection, after installation of subsequent Work.

3.05 CLEANING

A. Remove excess material, overspray, droppings, and debris.
B. Remove fireproofing from materials and surfaces not required to be fireproofed.
C. At exposed fireproofing, clean surfaces that have become soiled or stained, using manufacturer's recommended procedures.

DIVISION 07 81 23 – INTUMESCENT FIRE PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Thin-film intumescent fire resistive coatings (IFRC) for exposed structural steel.
B. Protective and/or decorative topcoats.

1.02 RELATED REQUIREMENTS

A. *Division 07 81 00* - Applied Fire Protection: Conventional cementitious and mineral fiber fireproofing.
B. *Division 09 90 00* - Painting and Coating: Field-applied paints matching intumescent fireproofing.
C. *Division 09 91 23* - Interior Painting: Field-applied paints matching intumescent fireproofing.

1.03 REFERENCE STANDARDS

A. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015e1.
B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
C. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
D. FM (AG) - FM Approval Guide; current edition.
E. SSPC-PA 2 - Procedure for Determining Conformance to Dry Coating Thickness Requirements; 2022.
F. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittals procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Performance characteristics and test results.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.
   5. Current UL Design numbers proposed for use with IFRC manufacturer listed.
C. Selection Samples: For decorative top coat, color chips representing manufacturer's full range of available colors, sheens and textures.
D. Verification Samples: For each thickness, color, sheen, and finish required, submit samples not less than 4 inches square on designated substrate illustrating finished appearance.
E. Certificates: Certify that intumescent fireproofing provided for this project meets or exceeds specified requirements in all respects.
F. Test Reports: Published fire resistive designs for structural elements of the types required for the project, indicating hourly ratings of each assembly.
G. Field Quality Control Submittals: Submit field test report.
H. Manufacturer's qualification statement.
I. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company that specializes in manufacturing the type of products specified, with minimum of ten years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.06 MOCK-UPS

A. Provide a mock-up for evaluation of surface preparation techniques and application workmanship; approved mock-up will serve as a standard of comparison for subsequent work of this section.
B. Finish at least 100 sq ft of surface in areas as designated by Architect/Engineer.
C. Evaluate mock-up for compliance with specified requirements, including thickness and finish texture.
D. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect/Engineer.
E. Refinish mock-up area as required to produce acceptable work.
F. Approved mock-up may remain as part of the project.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer’s original, unopened containers with identification labels and testing agency markings intact and legible.
B. Store products in manufacturer's unopened packaging until ready for installation.
   1. Store at temperatures not less than 50 degrees F in dry, protected area.
   2. Protect from freezing, and do not store in direct sunlight.
   3. Dispose of any materials that have come into contact with contaminants of any kind prior to application.
C. Dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.08 FIELD CONDITIONS

A. Protect areas of application from windblown dust and rain.

B. Maintain ambient field conditions, such as temperature, humidity, and ventilation, within limits recommended by manufacturer for optimum results. Do not install products under ambient conditions outside manufacturer's absolute limits.

1. Provide temporary enclosures as required to control ambient conditions.
2. Do not apply intumescent fireproofing when ambient temperatures are below 50 degrees F without specific approval from manufacturer.
3. Ensure that relative humidity is between 40 and 60 percent in areas of application.
4. Provide ventilation in enclosed spaces during application and for not less than 72 hours afterward.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Intumescent Thin-Film Fire Protection:

1. Albi Protective Coatings, a subsidiary of StanChem Polymers: www.albi.com/#sle.
2. Carboline Company: www.carboline.com.
3. Isolatek International Corp: www.isolatek.com/#sle.
4. Sherwin-Williams: www.industrial.sherwin-williams.com.
5. Approved Equal.
6. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 SYSTEM REQUIREMENTS

A. Fireproofing: Provide intumescent thin-film fire protection systems tested by an independent testing agency in accordance with ASTM E119 and acceptable to authorities having jurisdiction (AHJ).

1. Provide assemblies listed by FM (AG) or UL (FRD) and bearing listing agency label or mark.

B. Structural Steel Columns: Fire resistance rating of 1 hour; Design Number to be UL tested system by manufacturer.

2.03 MATERIALS

A. Fire Resistive Coating System: Thin-film intumescent fire protection system for structural steel.

1. Surface Burning Characteristics: Class A, flame spread/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
2. For Interior Use:
   a. Use only water-based products.
   b. Basis of Design: Carboline Company; FIREFILM III.
3. For Exterior Use:
   a. Use only epoxy-based products.
   b. Durometer Hardness, Type D: 45, minimum, in accordance with ASTM D2240.
   c. Basis of Design: Carboline Company; Nullifire S605.

B. Protective and Decorative Top Coating: As recommended by fireproofing manufacturer for exposure and substrate conditions.

1. Color and Gloss: As selected by Architect/Engineer.
2. Coordinate with paint for color and sheen to match intumescent fireproof coating and adjacent painted surfaces; see Section 09 9000.09 9123

C. Sealers and Primer: As required by tested and listed assemblies, and recommended by fireproofing manufacturer to suit specific substrate conditions.

D. Reinforcement: Glass fiber fabric matching type used in tested and listed assemblies.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates to determine if they are in satisfactory condition to receive intumescent fire protection; verify that substrates are clean and free of oil, grease, incompatible primers, or other foreign substances capable of impairing bond to fireproofing system.

B. Do not begin installation until substrates have been properly prepared.

C. If substrate preparation is responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Thoroughly clean surfaces to receive fireproofing.

B. Repair substrates to remove surface imperfections that could effect uniformity of texture and thickness of fireproofing system, and remove minor projections and fill voids that could telegraph through finished work.
C. Cover or otherwise protect other work that might be damaged by fallout or overspray of fireproofing system, and provide temporary enclosures as necessary to confine operations and maintain required ambient field conditions.

3.03 APPLICATION

A. Comply with manufacturer's instructions for each particular intumescent fire protection system installation application as indicated.
B. Apply manufacturer's recommended primer to required coating thickness.
C. Apply fireproofing to full thickness over entire area of each substrate to be protected.
D. Apply coats at manufacturer's recommended rate to achieve dry film thickness (DFT) as required for fire resistance ratings designated for each condition.
E. Apply intumescent fire protection by spraying to maximum extent possible, and as necessary complete coverage by roller application or other method acceptable to manufacturer.
F. Achieve uniform finished appearance complying with approved mock-up.

3.04 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with *Division 01 40 00* - Quality Requirements.
   1. Arrange for testing of installed intumescent fire protection by an independent testing laboratory using magnetic pull-off dry film thickness gauge in accordance with SSPC-PA 2, and ensure it meets requirements of authorities having jurisdiction (AHJ).
   2. Submit field test reports promptly to Contractor and Architect/Engineer.
B. Repair or replace intumescent fire protection at locations where test results indicate fireproofing does not meet specified requirements.

3.05 CLEANING

A. See *Division 01 70 00* - Execution and Closeout Requirements for additional requirements.
B. Immediately after installation of fireproofing in each area, remove overspray and fallout from other surfaces and clean soiled areas.

3.06 PROTECTION

A. Protect installed intumescent fire protection from damage due to subsequent construction activities, so fireproofing is without damage or deterioration before Date of Substantial Completion.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

DIVISION 07 84 00 – FIRE STOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.
B. Firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.
C. Definitions
   1. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.
   2. Barriers: Time-rated firewalls, smoke barrier walls, time-rated ceiling/floor assemblies and floors.
   3. Penetrations: Opening or foreign material passing through or into a barrier, such that full thickness of rated barrier materials is not obtained; gap between adjacent sections of time rated walls, time rated or exterior walls and structural floors or roof decks; and gap between adjacent sections of structural floors.
   4. Sealant System: Products and applications, specifically recognized by Underwriter's Laboratories, Inc., to close barrier penetrations.
   5. Sleeve: Heavy gauge metal fabrication or pipe section extending beyond surfaces of barrier and used to permanently guard penetration.

1.02 RELATED REQUIREMENTS

A. *Division 01 70 00* - Execution and Closeout Requirements: Cutting and patching.
B. *Division 03 30 00* - Cast-in-Place Concrete.
C. *Division 04 20 00* - Unit Masonry.
D. *Division 06 10 00* - Rough Carpentry.
E. *Division 07 21 00* - Thermal Insulation.
F. *Division 07 05 53* - Fire and Smoke Assembly Identification.
G. *Division 07 92 00* - Joint Sealants.
H. *Division 09 21 16* - Gypsum Board Assemblies: Gypsum wallboard fireproofing.
I. *Division 21* - Fire Protection.
J. *Division 22* - Plumbing.
K. *Division 23* - Mechanical Insulation.
L. *Division 26* - Electrical Materials and Methods.

1.03 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
C. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023b.
D. ITS (DIR) - Directory of Listed Products; current edition.
E. FM 4991 - Approval Standard of Firestop Contractors; 2013.
F. FM (AG) - FM Approval Guide; current edition.
G. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).
H. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
I. UL (DIR) - Online Certifications Directory; Current Edition.
J. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
D. Sustainable Design Submittal: Submit VOC content documentation for all non-preformed materials.
E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
G. Certificate from authority having jurisdiction indicating approval of materials used.
H. Installer Qualification: Submit qualification statements for installing mechanics.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
    1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
    2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
    3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.
C. Installer Qualifications: Company specializing in performing the work of this section and:
    1. Trained by the manufacturer. Written acceptability to or licensed by manufacturer.
    2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
    3. Verification of minimum three years documented experience installing work of this type.
    4. Verification of at least five satisfactorily completed projects of comparable size and type.
    5. Licensed by local authorities having jurisdiction (AHJ).

D. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

1.06 MOCK-UP

A. Where firestopping is intended to fill a linear opening, install minimum of 1 linear ft.
B. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.
C. If accepted, mock-up will represent minimum standard for the Work.
D. If accepted, mock-up may remain as part of the Work. Remove and replace mock-ups not accepted.

1.07 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type and UL label where applicable.
B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at jobsite.
C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
E. Do not use damaged or expired materials.

1.09 COORDINATION

A. Coordinate location and proper selection of cast-in-place firestop devices with trade responsible for the work. Ensure device is installed before placement of concrete.
B. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:
   1. 3M Fire Protection Products: www.3m.com/firestop/#sle.
   2. A/D Fire Protection Systems Inc: www.adfire.com/#sle.
   3. Grabber Construction Products, Inc; GrabberGard EFC: www.grabberman.com/#sle.
   4. Hilti, Inc: www.us.hilti.com/#sle.
   5. Nelson FireStop Products: www.nelsonfirestop.com/#sle.
   6. Specified Technologies Inc: www.stifirestop.com/#sle.
   7. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: www.tremcosealants.com/#sle.
   8. Approved Equal.
   9. Substitutions: See *01 60 00* - Product Requirements.

2.02 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.
B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
C. Mold and Mildew Resistance: Provide firestoppping materials with mold and mildew resistance rating of zero (0) in accordance with ASTM G21.
D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
E. Fire Ratings: Refer to drawings for required systems and ratings.
F. Provide firestopping composed of components compatible with each other, substrates forming openings, and items, if any, penetrating firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
G. Provide components for each firestopping system needed to install fill material. Use only components specified by firestopping manufacturer and approved by qualified testing agency for designated fire-resistance-rated systems.
H. Firestopping materials are either "cast-in-place" (integral with concrete placement) or "post

installed." Provide cast-in-place firestop devices prior to concrete placement.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.
   2. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
   3. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
   4. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.

B. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.

C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.
   2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
   3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
   4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
   1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
   2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
   3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
   4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.04 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.
   2. Fire Ratings: See drawings for required systems and ratings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
B. Remove incompatible materials that could adversely affect bond.
C. Install backing materials to prevent liquid material from leakage.
D. Verify penetrations are properly sized and in suitable condition for application of materials.
E. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
F. Do not proceed until unsatisfactory conditions have been corrected.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
C. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating adjacent surfaces.

D. Install labeling required by code.
E. Regulatory Requirements: Install firestop materials in accordance with published "Through Penetration Firestop Systems" in UL's Fire Resistance Directory.
F. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration materials.
    1. Seal all holes or voids made by penetrations to ensure an air and water-resistant seal.
    2. Consult with mechanical engineer, project manager prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
    3. Protect materials from damage on surfaces subjected to traffic.
G. Install fire-stopping, at least equal to barrier fire-rating, in and around penetrations of floor structures, exterior walls and interior walls indicated as time rated fire barriers or smoke barriers.
H. Install fire-stopping to close clearances around and within sleeves, and around cables, conduits, pipes, ducts, equipment enclosures, or other apparatus causing penetration of barrier.
I. Patch penetrations caused by cutting or presence of unused or abandoned openings or boxes, using materials compatible with barrier construction and with fire rating equal to or greater than barrier rating.
J. To the greatest extent practicable, construct time-rated walls after placement of penetrating materials, fitting rated construction materials tightly to or directly on material of penetration.
K. Where large openings are created in barriers, to permit later installation of pipes and ducts, close unused portions of opening with solid fill equal to barrier rating and with applicable firestopping sealant system around penetrating items.
L. Fire-stop spaces in rated concrete or masonry wall openings with fire rated solid fill only where both height and width exceed thickness of rated barrier. Install applicable Fire-stopping system around all penetrating items.
M. Fire-stop penetrations through full thickness of barriers. Where required thickness of firestopping sealant system is less than thickness of barrier, use fiber fill, solid fill, or fiber packing to make up remainder of barrier thickness.
N. Completely fill void spaces of each penetration with fire-stopping material.
O. Provide forms and dams to permanently secure fire-stopping materials.
    1. Install fire-stopping in floors flush with top of slab, sleeve, or housekeeping pad.
P. Apply fire-stopping directly to penetrating item. Do not anchor or bond fire-stopping to combustible or non-fire rated materials such as plastic or fiber coverings.
Q. Where sleeves have been installed surrounding pipes or other penetrations, fire-stop annular space between sleeve and its contained pipe or duct with resilient fire-stopping sealant system to permit movement of pipe or duct without damage to fire-stopping sealant.
R. Place fire-stopping of annular space around fire dampers before installation of damper anchoring flanges.

3.04 FIELD QUALITY CONTROL

A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174, and ASTM E2393.
B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

DIVISION 07 92 00 – JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag (N) gunnable joint sealants:
    1. Silicone (N-S1, N-S2).
    2. Urethane (N-U1, N-U2, N-U3, N-U4).
    3. Epoxy. (N-E1).
    4. Polysulfide (N-P1).
    5. Acrylic (N-A1).

6. Butyl (N-B1, N-B2).

B. Self-leveling pourable (P) joint sealants:
   1. Silicone (P-S1).
   2. Urethane (P-U1).
   3. Polysulfide (P-P1).
   4. Epoxy (P-E1).
   5. Polyurea (P-PU1).

C. Joint backings and accessories.

D. Acoustical joint sealants.

E. Preformed seals.

1.02 RELATED REQUIREMENTS

A. *Division 04 20 00* - Unit Masonry: Sealants for control and expansion joints.

B. *Division 07 08 00* - Commissioning of Building Envelope

C. *Division 07 13 00* - Sheet Waterproofing: Sealing cracks and joints in waterproofing substrate surfaces using materials specified in this section.

D. *Division 07 27 00* - Air Barriers: Sealants required in conjunction with air barriers and vapor retarders.

E. *Division 07 84 00* - Firestopping: Firestopping sealants.

F. *Division 07 95 13* - Expansion Joint Cover Assemblies: Sealants forming part of expansion joint cover assemblies.

G. *Division 08 71 00* - Door Hardware: Setting exterior door thresholds in sealant.

H. *Division 08 80 00* - Glazing: Glazing sealants and accessories.

I. *Division 09 21 16* - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

J. *Division 09 30 00* - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

K. *Division 23 31 00* - HVAC Ducts and Casings: Duct sealants.

L. *Division 32 13 13* - Concrete Paving: Sealants for joints.

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.

B. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2015a.

C. ASTM C834 - Standard Specification for Latex Sealants; 2017.

D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012 (Reapproved 2017).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

F. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.

G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

H. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.

I. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).

J. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2013.

K. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015e1.

L. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Product Data for Sealants: Submit manufacturers' technical data sheets for each product to be used, that includes the following.
   1. Substrates for which use of primer is required.
   2. Substrates for which laboratory adhesion and/or compatibility testing are required.
   3. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
   4. Sample product warranty.
   5. Certification by manufacturer indicating that product complies with specification

requirements.

6. SWRI Validation: Provide currently available sealant product validations as listed by SWRI (VAL) for specified sealants.

C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

E. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect/Engineer and submit at least two physical samples for verification of color of each required sealant.

F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

G. Installation Plan: Submit at least four weeks prior to start of installation.

H. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

I. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

J. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

K. Installation Log: Submit filled out log for each length or instance of sealant installed.

L. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

E. Installation Plan: Include schedule of sealed joints, including the following.

1. Joint width indicated in Contract Documents.
2. Joint depth indicated in Contract Documents; to face of backing material at centerline of joint.
3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgement that some surfaces cannot be cleaned to like-new conditions and therefore prevention is imperative.
4. Approximate date of installation, for evaluation of thermal movement influence.
    a. Unique identification of each length or instance of sealant installed.
    b. Location on project.
    c. Substrates.
    d. Sealant used.
    e. Stated movement capability of sealant.
    f. Primer to be used or indicate as "No primer" used.
    g. Size and actual backing material used.
    h. Name of installer.
    i. Actual joint depth to face of backing material at centerline of joint.

F. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.

1. Identification of testing agency.
2. Name(s) of sealant manufacturers' field representatives who will be observing
3. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
    a. Substrate; if more than one type of substrate is involved in a single joint, provide two entries on form, for testing each sealant substrate side separately.

b. Test date.
c. Location on project.
d. Sealant used.
e. Stated movement capability of sealant.
f. Test method used.
g. Date of installation of field sample to be tested.
h. Date of test.
i. Copy of test method documents.
j. Age of sealant upon date of testing.
k. Test results, modeled after the sample form in the test method document.
l. Indicate use of photographic record of test.

G. Field Quality Control Plan:
1. Visual inspection of entire length of sealant joints.
2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
a. Test the entire length of every sealant joint.
b. For each different sealant and substrate combination, allow for one test every 12 inches in the first 10 linear feet of joint and one test every 24 inches thereafter.
c. If any failures occur in the first 10 linear feet, continue testing at 12 inches intervals at no extra cost to Owner.
3. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1000 linear feet, and one test per 1000 linear feet thereafter, or once per floor on each elevation.
b. If any failures occur in the first 1000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.
4. Field testing agency's qualifications.
5. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

H. Field Adhesion Test Procedures:
1. Allow sealants to fully cure as recommended by manufacturer before testing.
2. Have a copy of the test method document available during tests.
3. Take photographs or make video records of each test, with joint identification provided in the photos/videos; for example, provide small erasable whiteboard positioned next to joint.
4. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
5. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
6. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
7. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect/Engineer.

I. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
1. Record results on Field Quality Control Log.
2. Repair failed portions of joints.

J. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
1. Sample: At least 18 inches long.
2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary

measures to correct conditions and re-test; record each modification to products or installation procedures.
4. Record results on Field Quality Control Log.
5. Repair failed portions of joints.

K. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.

1.06 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Non-Sag Sealants: Gunnable or non-sag sealants permits application in joints on vertical surfaces without sagging or slumping.
1. Adhesives Technology Corporation: www.atcepoxy.com.
2. Bostik Inc: www.bostik-us.com.
3. Dow Corning Corporation: www.dowcorning.com/construction/sle.
4. Fortifiber Building Systems Group: www.fortifiber.com/sle.
5. Franklin International, Inc: www.titebond.com.
6. Pecora Corporation: www.pecora.com/?sle.
7. The QUIKRETE Companies: www.quikrete.com.
8. Sherwin-Williams Company: www.sherwin-williams.com.
9. Sika Corporation: www.usa-sika.com.
10. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
11. W.R. Meadows, Inc: www.wrmeadows.com/sle.
12. Substitutions: See *01 60 00* - Product Requirements.

B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
1. Adhesives Technology Corporation: www.atcepoxy.com.
2. Bostik Inc: www.bostik-us.com.
3. Dow Corning Corporation: www.dowcorning.com/construction/sle.
4. Pecora Corporation: www.pecora.com/?sle.
5. The QUIKRETE Companies: www.quikrete.com.
6. Sherwin-Williams Company: www.sherwin-williams.com.
7. Sika Corporation: www.usa-sika.com.
8. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
9. W.R. Meadows, Inc: www.wrmeadows.com/sle.
10. Substitutions: See *01 60 00* - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on the drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items:
a. Concealed transition joints in air barrier.
b. Movement joints in concrete unit masonry.
c. Movement joints in brick masonry.
d. Joints within exterior insulation finish system (EIFS).
e. Wall expansion and control joints.
f. Exposed joints in metal panel cladding systems.
g. Concealed watertight joints in cladding systems.
h. Perimeter joints between frames of doors, windows, storefront frames, curtain wall frames, louvers, and other frames and adjacent construction. Do not seal or block weep holes.
i. Joints within aluminum storefront framing, curtain walls, and window systems. Do not seal or block weep holes.
j. Other exterior non-traffic joints.
k. Horizontal traffic and traffic isolation joints: Refer to Division 32 Sections.
l. Joints between different exposed materials.

m. Openings below ledge angles in masonry.

2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
   a. Perimeter joints of exterior doors, windows, storefront frames, curtain wall frames, louvers, and other frames, and adjacent construction.
   b. Perimeter joints between frames of doors, windows, and other frames and adjacent construction.
   c. Sanitary joints between plumbing fixtures, food preparation fixtures, casework and adjacent walls, floors and counters.
   d. Traffic joints in floor and between floor and wall construction.
   e. Non-moving joints between painted surfaces and adjacent materials.
   f. Concealed sealants at thresholds and sills.
   g. Exposed and non-exposed applications in sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
      1) Exception: Such gaps and openings in gypsum board finished stud walls and suspended ceilings.
      2) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
3. Do not seal the following types of joints.
   a. Intentional weepholes in masonry.
   b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.

B. Exterior Joints: Use non-sag non-staining silicone sealant, Type N-S1, unless otherwise indicated.
1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing; Type N-B1.
2. Lap Joints between Manufactured Metal Panels: Butyl rubber, non-curing; Type N-B2.
3. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant; Type P-U1.
4. Wiring Slots in Concrete Paving: Self-leveling epoxy sealant; Type P-E1.
5. Cooling Tower and Fountain Basins: Non-sag polyurethane sealant for continuous immersion; Type P-U2.
6. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion; Type N-U2.
7. Floor Joints in Wet Areas: Self-leveling polyurethane "traffic-grade" sealant suitable for continuous liquid immersion; Type P-U2.
8. Wall, Ceiling, and Floor Joints Where Tamper-Resistance is Required: Non-sag tamper-resistant polyurethane sealant; Type N-U4.
9. In Sound-Rated Assemblies: Acrylic emulsion latex sealant; Type N-A1.
10. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant; Type P-E1.
11. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant; Type P-U3.

C. Interior Joints: Use non-sag polyurethane sealant, Type N-U1, unless otherwise indicated.
1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant; Type N-A1.
2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion; Type N-U2.
3. Floor Joints in Wet Areas: Self-leveling polyurethane "traffic-grade" sealant suitable for continuous liquid immersion; Type P-U2.
4. Wall, Ceiling, and Floor Joints Where Tamper-Resistance is Required: Non-sag tamper-resistant polyurethane sealant; Type N-U4.
5. In Sound-Rated Assemblies: Acrylic emulsion latex sealant; Type N-A1.
6. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant; Type P-E1.
7. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant; Type P-U3.

D. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or

"acoustical".

F. Areas Where Tamper-Resistance is Required: Restrooms and locker rooms.

G. Colors: As indicated on the drawings or, if not indicated, as selected by Architect from manufacturer's standard color range.

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 01 6116.

B. ASTM C920 Joint Sealant Types, Grades, Classes, Exposure Uses and Substrate Uses that are referenced in this section:
   1. Type S: Single Component.
   2. Type M: Multi-Component.
   3. Grade P: Pourable.
   4. Grade NS: Non-sag.
   5. Class XX: Movement capability, percent.
   6. Class XX/YY: Movement capability, percent, expansion/contraction.
   7. Exposure Use I: Immersion.
   8. Exposure Use T: Traffic.
   9. Exposure Use NT: Non-traffic.
   10. Substrate Use G: Glass.
   11. Substrate Use M: Mortars.
   12. Substrate Use A: Aluminum.
   13. Substrate Use O: Other.

2.04 NONSAG JOINT SEALANTS

A. SILICONE Type 1/N-S1 - Single Component, Nonsag, Non-Staining, Neutral Moisture Curing Silicone Sealant: ASTM C920, Type S, Grade NS, Class 100/50, Uses NT, M and A; not expected to withstand continuous water immersion or traffic.
   1. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
   2. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
   3. Service Temperature Range: Minus 65 to 180 degrees F.
   4. Manufacturers:
      a. Dow Corning Corporation; 790 Silicone Building Sealant: www.dowcorning.com/construction/sle.
      b. Pecora Corporation; 890NST Ultra Low Modulus Architectural Silicone Sealant: www.pecora.com.
      c. Sika Corporation; Sikasil WS-290: www.usa-sika.com/#sle.
      d. Tremco, Inc. Commercial Sealants, Spectrem 1: www.tremcosealants.com

B. URETHANE Type N-U1 - Nonsag, Moisture Curing, Polyurethane Sealant: ASTM C920, Type S, Grade NS, Class 50, Uses NT, M and A; single component not expected to withstand continuous water immersion or traffic.
   1. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
   2. Service Temperature Range: Minus 40 to 180 degrees F.
   3. Manufacturers:
      a. Pecora Corporation; DynaTrol II: www.pecora.com/#sle.
      b. Sika Corporation; Sikaflex-1a: www.usa-sika.com/#sle.
      c. Tremco, Inc. Commercial Sealants; Dymonic 100: www.tremcosealants.com.

C. URETHANE Type N-U2 - Nonsag, Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Type M, Grade NS, Class 35, Uses T, O and I; multi-component; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface.
   1. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
   2. Service Temperature Range: Minus 40 to 180 degrees F.
   3. Manufacturers:
      a. Pecora Corporation; DynaTred: www.pecora.com.
      b. Pecora Corporation; Dynatrol II: www.pecora.com.
      c. Sika Corporation; Sikaflex-1a: www.usa-sika.com/#sle.

d. Tremco, Inc. Commercial Sealants; Dymeric 240 FC: www.tremcosealants.com.

D. URETHANE Type N-U3 - Multi-Component, Non-Sag "Traffic-Grade" Polyurethane Sealant: ASTM C920, Type M, Grade NS, Class 35, Uses T, O and I; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
   1. Hardness Range: 40 to 50, Shore A, when tested in accordance with ASTM C661.
   2. Service Temperature Range: Minus 40 to 180 degrees F.
   3. Manufacturers:
      a. Pecora Corporation; DynaTred: www.pecora.com.
      b. Sika Corporation; Sikaflex-2c: www.usa-sika.com.
      c. Tremco, Inc. Commercial Sealants; Vulkem 45 SSL: www.tremcosealants.com.

E. URETHANE Type N-U4 - Multi-Component, Nonsag, Tamper-Resistant Polyurethane Sealant: ASTM C920, Type M, Grade NS, Class 12-1/2, Uses T, NT, O, M, G, and A; not expected to withstand continuous water immersion or traffic.
   1. Hardness Range: 50 to 60, Shore A, when tested in accordance with ASTM C661.
   2. Service Temperature Range: Minus 40 to 180 degrees F.
   3. Manufacturers:
      a. Pecora Corporation: www.pecora.com/#sle.
      b. Sika Corporation; Sikaflex-2c NS TG: www.usa-sika.com.
      c. Approved. Equal.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.

F. ACRYLIC Type N-A1 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
   1. Color: Standard colors matching finished surfaces, Type OP (opaque).
   2. Grade: ASTM C834; Grade Minus 18 Degrees C (0 Degrees F).
   3. Manufacturers:
      a. Hilti, Inc; CP 506 Smoke and Acoustical Sealant: www.us.hilti.com/#sle.
      b. Hilti, Inc; CP 572 Smoke and Acoustical Spray Sealant: www.us.hilti.com/#sle.
      c. Pecora Corporation; AC-20 +Silicone: www.pecora.com/#sle.
      d. Sherwin-Williams Company; White Lightning 3006 Siliconized Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
      e. Substitutions: See *Division 01 60 00* - Product Requirements.

G. BUTYL Type N-B1 - Single-Component, Nonsag, Solvent-based Butyl Sealant; ASTM C1311; Type S, Grade NS, Class 10, not expected to withstand continuous water immersion or traffic.
   1. Hardness Range: 10 to 30, Shore A, when tested in accordance with ASTM C661.
   2. Service Temperature Range: Minus 13 to 180 degrees F.
   3. Manufacturers:
      a. Sherwin-Williams Company; Storm Blaster All Season Sealant: www.sherwin-williams.com/#sle.
      b. Pecora Corporation; BC-158: www.pecora.com.
      c. Tremco, Inc. Commercial Sealants, Tremco Butyl Sealant: www.tremcosealants.com.

H. BUTYL Type N-B2 - Single-Component, Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.
   1. Manufacturers:
      a. Pecora Corporation; Pecora BA-98 Non-Skinning Butyl Sealant: www.pecora.com/#sle.
      b. Substitutions: See *Division 01 60 00* - Product Requirements.

2.05 SELF-LEVELING SEALANTS

A. SILICONE Type P-S1 - Self-Leveling Silicone Sealant: ASTM C920, Type S, Grade P, Class 100/50, Uses T, M, G, A and O; single-component, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
   1. Hardness Range: 0 to 15, Shore A, when tested in accordance with ASTM C661.
   2. Service Temperature Range: Minus 80 to 350 degrees F.
   3. Manufacturers:
      a. Sika Corporation; Sikasil 728SL: www.usa-sika.com/#sle.

b. Substitutions: See *01 60 00* - Product Requirements.

B. URETHANE Type P-U1 - Self-Leveling Polyurethane Sealant: ASTM C920, Type S, Grade P, Class 25, Uses T, M, G, and A; single component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.
   1. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
   2. Service Temperature Range: Minus 40 to 180 degrees F.
   3. Manufacturers:
      a. Pecora Corporation; NR-200 Self-Leveling Traffic-Grade Polyurethane Sealant: www.pecora.com.
      b. Sherwin-Williams Company; LOXON SL1 Polyurethane Sealant: www.sherwin-williams.com.
      c. Sika Corporation; Sikaflex-1c SL: www.usa-sika.com/#sle.
      d. Substitutions: See 01 6000 - Product Requirements.

C. URETHANE Type P-U2 - Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Type S, Grade P, Class 25, Uses T, I, M, G, and A; single component; explicitly approved by manufacturers for traffic exposure and continuous water immersion.
   1. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
   2. Service Temperature Range: Minus 40 to 180 degrees F.
   3. Manufacturers:
      a. Sika Corporation; Sikaflex-1c SL: www.usa-sika.com/#sle.
      b. W. R. MEADOWS, Inc; POURTHANE SL: www.wrmeadows.com/#sle.
      c. Substitutions: See *01 60 00* - Product Requirements.

D. URETHANE Type P-U3 - Rigid Self-Leveling Polyurethane Joint Filler: Two-part, low viscosity, fast setting; intended for cracks and control joints not subject to significant movement.
   1. Hardness Range: Greater than 100, Shore A, and 50 to 80, Shore D, when tested in accordance with ASTM C661.
   2. Service Temperature Range: Minus 0 to 110 degrees F.
   3. Manufacturers:
      a. ARDEX Engineered Cements; ARDEX ARDIFIX: www.ardexamericas.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

E. EPOXY Type P-E1 - Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; Type M, Grade P, Uses T; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
   1. Composition: Multi-component, 100 percent solids by weight.
   2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
   3. Joint Width, Minimum: 1/8 inch.
   4. Joint Width, Maximum: 1/4 inch.
   5. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.
   6. Manufacturers:
      a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
      b. Nox-Crete Inc; DynaFlex 502: www.nox-crete.com/#sle.
      c. W.R. Meadows, Inc; Rezi-Weld Flex: www.wrmeadows.com/#sle.

F. POLYUREA Type P-PU1 - Multi-Component, Semi-Rigid Self-Leveling Polyurea Joint Filler: Type M, Grade P, 100 percent solids; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic from forklifts, carts or heavy equipment.
   1. Durometer Hardness, Type A: 75, minimum, after seven days when tested in accordance with ASTM D2240.
   2. Service Temperature Range: Minus 40 to 180 degrees F.
   3. Joint Width, Minimum: 1/8 inch.
   4. Joint Width, Maximum: 3/4 inch.
   5. Joint Depth: Provide product suitable for joints from 1/8 inch to 1 inch in depth excluding space for backer rod.

6. Manufacturers:
    a. Adhesives Technology Corporation; Crackbond JF-311: www.atcepoxy.com/#sle.
    b. Nox-Crete Inc; DynaFlex JF-85: www.nox-crete.com/#sle.

2.06 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
    1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
    2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type C - Closed Cell Polyethylene.
    3. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
    4. Open Cell: 40 to 50 percent larger in diameter than joint width.
    5. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
    6. Manufacturers:
        a. Nomaco, Inc; HBR, closed cell polyethylene backer rod: www.nomaco.com.
        b. Nomaco, Inc; OCFoam, open cell polyurethane backer rod: www.nomaco.com.
        c. Nomaco, Inc; SOF Rod bi-cellular polyethylene backer rod: www.nomaco.com.
        d. W.R Meadows, Inc., KOOL-ROD, closed cell polyethylene backer rod: www.wrmeadows.com.
B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.
B. Verify that backing materials are compatible with sealants.
C. Verify that backer rods are of the correct size.
D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
    1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
    2. Notify Architect/Engineer of date and time that tests will be performed, at least seven days in advance.
    3. Record each test on Preinstallation Adhesion Test Log as indicated.
    4. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect/Engineer.
    5. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.
B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform installation in accordance with ASTM C1193.
C. Perform acoustical sealant application work in accordance with ASTM C919.

D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
E. Install bond breaker backing tape where backer rod cannot be used.
F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

A. Owner will employ an independent testing agency to perform field quality control inspection and testing as specified in PART 1 under QUALITY ASSURANCE article.
B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
C. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect/Engineer immediately.
D. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect/Engineer immediately.
E. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
F. Refer to Section 07 0800 for Commissioning of Building Envelope testing of exterior sealants

3.05 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

DIVISION 07 95 13 – EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion joint cover assemblies for floor, wall, ceiling, soffit, and roof surfaces.

1.02 RELATED REQUIREMENTS

A. *Division 04 20 00* - Unit Masonry: Placement of joint cover assembly frames in masonry.
B. *Division 05 50 00* - Metal Fabrications: Custom fabricated metal expansion and control joint devices.
C. *Division 07 62 00* - Sheet Metal Flashing and Trim: Roof expansion and control joint covers.
D. *Division 07 92 00* - Joint Sealants: Sealing expansion and control joints using gunnable and pourable sealants.
E. *Division 09 21 16* - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.

1.03 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.
D. ITS (DIR) - Directory of Listed Products; current edition.
E. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction and anchorage locations.
D. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Expansion Joint Cover Assemblies:
1. Balco, Inc: www.balcousa.com/#sle.
2. Construction Specialties, Inc: www.c-sgroup.com/#sle.
3. EMSEAL Joint Systems, Ltd: www.emseal.com/#sle.
4. Inpro: www.inprocorp.com/#sle.
5. MM Systems Corp: www.mmsystemscorp.com/#sle.
6. Nystrom, Inc: www.nystrom.com/#sle.
7. Watson Bowman Acme Corporation: www.watsonbowmanacme.com/#sle.
8. Approved Equal.
9. Substitutions: See *01 60 00* - Product Requirements.

2.02 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

A. Interior Floor to Floor Joints:
1. Manufacturers:
a. Balco, Inc; BHS-Hinge.
b. Construction Specialties, Inc; RFD.
c. Inpro; 806SD-A01:
d. See *01 60 00* - Product Requirements.

B. Interior Wall to Wall Vertical, Wall to Wall Horizontal (between door heads), and Wall to Ceiling Joints:
1. Manufacturers:
a. Balco, Inc; WD and WDC Wall to Wall and Wall to Corner.
b. Construction Specialties, Inc; ASM and ASM-C
c. Inpro; 811-A07 and 811-A09:
d. See *01 60 00* - Product Requirements.

C. Exterior Concealed Wall Joints at CMU to CMU in plane with Air Barrier – 50%:
1. Manufacturers:
a. Balco, Inc; Exterior Wall, BBSW or FCVS.
b. Construction Specialties, Inc; SF or VF
c. EMSEAL Joint Systems, Ltd; 25V or Seismic Colorseal.
d. Inpro; 676-G07 and G09
e. Substitutions: See *01 60 00* - Product Requirements.

D. Exterior Wall Joints at Brick to Brick, Brick to Tile and Brick to Metal Panel:
1. Manufacturers:
a. Balco, Inc; Exterior Wall, Elastomeric Face Seal System; FCWW.
b. Construction Specialties, Inc; SF or VF
c. EMSEAL Joint Systems, Ltd; Seismic Colorseal.
d. Inpro; 615-A07 and A09:
e. See *01 60 00* - Product Requirements.

E. Exterior, Below Grade, Blind-Side and Positive-Side, and Under-Slab Joints:
1. Manufacturers:
a. EMSEAL Joint Systems, Ltd; BG System: www.emseal.com/#sle.
b. SITURA Inc; RedLINE Waterproof Expansion Joint Systems: www.situra.com/#sle.
c. *Division 07 10 00* Sheet Waterproofing Manufacturer's approved joint systems
d. See *01 60 00* - Product Requirements.

2.03 EXPANSION JOINT COVER ASSEMBLIES

A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
   1. Joint Dimensions and Configurations: As indicated on drawings.
   2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
   3. Joint Cover Styles: As indicated on drawings.
   4. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
   5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
   6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

B. Resilient Seal Type Covers: Having flat exposed surface without crevices that could collect dirt; designed to withstand expected movement without extrusion of seal from joint assembly; for floors, provide style that is flush with top of floor covering; for exterior joints, weathertight.

C. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.

D. Covers in Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.

E. Covers in Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.
   1. Acceptable Evaluation Agencies: UL (DIR) and ITS (DIR).

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
   1. Exposed Finish Outdoors: Natural anodized.
   2. Exposed Finish at Walls and Ceilings: Natural anodized.

B. Resilient Seals:
   1. For Ceilings: Any resilient material, flush, pleated, or hollow gasket.
   2. Color: To be selected by Architect/Engineer .

C. Anchors and Fasteners: As recommended by cover manufacturer.

D. Ferrous Metal Anchors: Galvanized where embedded in concrete or in contact with cementitious materials.

E. Threaded Fasteners: Aluminum.

F. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

2.05 FINISHES

A. Santoprene seals to be selected by Architect from manufacturer's standard colors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.02 PREPARATION

A. Provide anchoring devices for installation and embedding under *Division 03 10 00*.
   1. Provide templates and rough-in measurements.

B. Provide anchoring devices for installation and embedding under *Division 04 20 00*.
   1. Provide templates and rough-in measurements.

C. Install anchoring devices in conformance to templates

3.03 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Align work plumb and level, flush with adjacent surfaces.

C. Rigidly anchor to substrate to prevent misalignment.

3.04 PROTECTION

A. Do not permit traffic over unprotected floor joint surfaces.

B. Provide strippable coating to protect finish surface.

DIVISION 08 11 13 – HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

All exterior doors are to be recessed or otherwise protected from direct exposure to precipitation. Construction shall be of heavy-duty weatherproof design with energy-efficient glass to minimize leaks, promote energy conservation, and reduce maintenance problems. MSCS recommends that when double doors are used that a keyed removable mullion be included in the design to allow for large objects and service equipment such as vending machines, maintenance equipment, lifts, etc. to access the opening.

Heavy-duty hollow metal doors and frames are required for school usage.
Aluminum doors and frames shall be considered and if used, shall be designed for high traffic use and security; heavy-duty steel, 16 gauge minimum, with a wraparound design is preferred. Particular attention needs to be given to the preparation and reinforcement for hardware. Doors shall be 1¾" thick and 7'-0" in height or match existing heights where applicable. Doors shall be 36” wide minimum. Generally, entrance doors shall have large vision panels or be hollow metal-framed glass doors. Interior stairs/corridors doors shall have vision lights as allowed by the applicable codes.

EXTERIOR HOLLOW METAL DOORS and FRAMES: Shall be SDI Grade III, extra heavy model 2A (seamless) which requires face sheets of 14 gage minimum. Exterior doors and frames shall be of galvanized steel construction including reinforcement, louvers and other accessories. Top of exterior doors shall be closed flush and welded watertight. Frames shall be welded and fabricated from 14-gauge cold rolled steel. All exterior doors shall be insulated. All exterior hollow metal doors shall be hung on full mortise heavy duty butt-hinges, stainless steel finish.

INTERIOR HOLLOW METAL DOORS AND FRAMES: Shall be SDI Grade III, extra heavy duty, Model 2 (seamless) which requires face sheets of 16 gauge minimum. Interior frames shall be welded and fabricated from 16 gauge cold rolled steel.
HOLLOW METAL GLAZING FRAMES: Shall be fabricated from 14 gauge cold rolled steel. Where used on the exterior both frame and glazing stops shall be made from galvanized sheet metal and glazing stops shall be prime coated prior to assembling.

FRAME ANCHORAGE: Jamb anchors at masonry wall openings shall be 16 gage galvanized T-Buck design. Frames at masonry walls shall be filled with grout. Jamb anchors for plaster and gypsum wallboard partition openings shall be a minimum of 18-gauge steel welded Z shape. Provide floor anchors at all frames.

FINISH HARDWARE REINFORCEMENT: Door and frame reinforcement shall be a minimum of 9 gauge for hinges and be a continuous channel for the full height of door, 12 gauge for closers and be a continuous channel for the full length of the header, and 14 gauge for strikes and be a continuous channel for the full height of the door. 7-gauge reinforcements shall be used for hinges on frames. Twenty-six (26) gauge steel plaster guards or mortar boxes welded to the frame shall be provided at hardware cutouts where installed in concrete, masonry, or plaster openings.

VISION LIGHTS: Shall be provided at classroom, stairs and corridor doors as the current adopted code allows. Coordinate exit device locations with vision lights as applicable to avoid overlapping.
LOUVERS: Shall be sight-proof, weatherproof louvers constructed of 24-gauge steel V or Y shaped blades set in 20-gauge frame. A galvanized wire mesh insect screen shall be provided at the inside face of exterior door louvers. Louvers shall have an applied factory finish with a minimum 10-year warranty.

FINISH PREPARATION: The exposed surfaces of door and frame units including galvanized surfaces shall be cleaned, bonderized, and shop primed using manufacturer's standard baked-on rust inhibitive primer.

DOOR AND FRAME LAYOUT: It is recommended for exterior, main entrance doors to be multiple, single doors swinging in the same direction. Double doors are not to be used in any situation without approval of Department of Major Construction. Corridor doors may be double if hold open devices are used. If possible, where wide openings are needed for movement of large equipment, etc., removable mullions may be specified. However, oversized single doors are preferred.

MAIN MECHANICAL EQUIPMENT ROOMS: Shall have 4'-0" exterior doors with kick plates where possible. Elevator equipment room doors shall be per elevator manufacturer's requirements, minimum 4'-0"
EXTERIOR DOORS AT KITCHEN FROM DOCK: Single 4'-0" door with armor plate, peep hole and doorbell. A tinted and laminated vision panel will be considered on a case-by-case basis.

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.
B. Hollow metal frames for wood doors.
C. Fire-rated hollow metal doors and frames.
D. Thermally insulated hollow metal doors with frames.
E. Sound-rated hollow metal doors and frames.
F. Tornado-resistant hollow metal doors and frames.
G. Hollow metal borrowed lites glazing frames.
H. Accessories, including glazing, louvers, and matching panels.

1.02 RELATED REQUIREMENTS

A. *Division 08 71 00* - Door Hardware.
B. *Division 08 80 00* - Glazing: Glass for doors and borrowed lites.
C. *Division 09 90 00* - Painting and Coating: Field painting.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2003 (R2009).
D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.
H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.
I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
J. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
L. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
M. ASTM E413 - Classification for Rating Sound Insulation; 2016.
N. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.
O. ICC 500 - ICC/NSSA Standard for the Design and Construction of Storm Shelters; National Storm Shelter Association; 2014.
P. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
Q. ITS (DIR) - Directory of Listed Products; current edition.
R. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
S. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
T. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
U. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
V. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
W. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.
X. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2018.

Y. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.
Z. UL (DIR) - Online Certifications Directory; Current Edition.
AA. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
BB. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See *Section 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
D. Design Submittals: Manufacturer to submit anchor design analysis calculations for tornado-resistant doors signed and sealed by specialty design engineer experienced in this type of work and licensed in the State in which the Project is located.
E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
F. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: https://steeldoor.org/sdi-certified/#sle.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
C. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
1. Basis of Design: Steelcraft, an Allegion brand; L Series Flush Doors: www.allegion.com/#sle.
2. Ceco Door, an Assa Abloy Group Company; Legion Flush Doors: www.assaabloydss.com/#sle.
3. Curries, an Assa Abloy Group Company: www.assaabloydss.com/#sle.
4. Premier Steel Doors and Frames; Omni Steel Doors: www.trustpremier.com/#sle.
5. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
6. Stiles, an ASSA Abloy Group Company; www.assaabloydss.cm/#sle.
7. Technical Glass Products, an Allegion brand: www.tgpamerica.com/#sle.
8. Titan Metal Products, Inc: www.titanmetalproducts.com/#sle.
9. Approved Equal.
10. Substitutions: See *01 60 00* - Product Requirements.

B. Tornado-Resistant Hollow Metal Doors and Frames:
1. Basis of Design: Ceco Door, an Assa Abloy Group Company; StormPro Series; www.assaabloydss.com/#sle.
2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Krieger Specialty Products: www.kriegerproducts.com/#sle.
4. Premier Steel Doors and Frames; Severe Windstorm Rated Doors & Frames: www.trustpremier.com/#sle.
5. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
6. Approved Equal.
7. Substitutions: See *01 60 00* - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:

1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
4. Door Edge Profile: Manufacturers standard for application indicated.
5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
    a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Hollow Metal Panels: Same construction, performance, and finish as doors.

C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Classification Level 3 - Extra Heavy-duty.
    b. Physical Endurance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 2 - Seamless.
    d. Door Face Metal Thickness: 14-gauge, 0.067 inch, minimum.
    e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Door Edge Design: Manufacturer's standard design
3. Door Core Material: Polystyrene, 1 lbs/cu ft minimum density.
    a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
4. Door Thermal Resistance: R-Value of 6.0 minimum, for installed thickness of polystyrene.
5. Door Thickness: 1-3/4 inches, nominal.
6. Top Closures: 0.042-inch-thick flush channel, flush with top of faces and edges.
7. Bottom Closures: 0.042-inch-thick inverted channel.
8. Weatherstripping: Refer to *Section 08 71 00*.

C. Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Classification Level 3 - Extra Heavy-duty.
    b. Physical Endurance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 2 - Seamless.
    d. Door Face Metal Thickness: 16-gauge, 0.053-inch, minimum.
2. Door Edge Design: Manufacturer's standard design
3. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
4. Door Thickness: 1-3/4 inches, nominal.
5. Top Closures: 0.042-inch-thick flush channel, flush with top of faces and edges.

6. Bottom Closures: 0.042-inch-thick flush channel, flush with top of faces and edges.

D. Fire-Rated Interior Doors:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Classification Level 3 - Extra Heavy-duty.
      b. Physical Endurance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 2 - Seamless.
      d. Door Face Metal Thickness: 16-gauge, 0.053-inch, minimum.
   2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
   3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
      a. Attach fire rating labels to each fire rated unit.
   4. Smoke and Draft Control Doors (Indicated with letter "S" on Drawings and/or Door Schedule): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;
      a. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10-inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
      b. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
      c. Label: Include the "S" label on fire-rating label of door.
   5. Door Edge Design: Manufacturer's standard design
   6. Door Core Material: Mineral board.
   7. Door Thickness: 1-3/4 inches, nominal.
   8. Top Closures: 0.042-inch-thick flush channel, flush with top of faces and edges.
   9. Bottom Closures: 0.042-inch-thick flush channel, flush with top of faces and edges.

E. Sound-Rated Interior Doors: All classroom doors and as indicated on Door Schedule.
   1. Sound Resistant Doors: Subject to the same compliance standards and requirements as standard hollow metal doors, provide manufacturer's standard sound resistant acoustic core tested in accordance with ASTM E90, ASTM 413, and ASTM E1332 standards.
   2. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Classification Level 3 - Extra Heavy-duty.
      b. Physical Endurance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 2 - Seamless.
      d. Door Face Metal Thickness: 16-gauge, 0.053-inch, minimum.
   3. Sound Transmission Class (STC) Rating of Door and Frame Assembly: STC of 32, 38, 41, 43, 46, 50, 52, 54) as indicated on the door schedule, calculated in accordance with ASTM E413, and tested in accordance with ASTM E90.
   4. Each unit to bear a physical label applied to door certifying the product construction and identifying the specific STC rating.
   5. Door Core Material: Manufacturer's standard construction as required to meet acoustic requirements indicated.
   6. Door Thickness: 1-3/4 inch.
   7. Glazing: 1” tempered and insulated glass units where scheduled.
   8. Top Closures: 0.042-inch-thick flush channel, flush with top of faces
   9. Top Closures: 0.042-inch-thick flush channel, flush with top of faces and edges.
   10. Bottom Closures: 0.042-inch-thick flush channel, flush with top of faces and edges.
   11. Opening Force of Sound-Rated Doors, Non-Fire-Rated: 5 pounds, maximum, in compliance with ADA Standards.

F. Tornado-Resistant Doors and Shutter Assemblies:
   1. General: Provide complete tornado storm shelter resistant assemblies constructed, test, and listed/labeled to resist the design pressures for components and cladding and missile impact resistance as described in ICC 500 (2014/2020), ICC/NSSA Standard for the Design and Construction of Storm Shelters.
      a. Door and shutter systems tested and complying with ICC 500 (2014/2020) and FEMA P-361 (2015/2021), Design and Construction Guidance for Community Safe Rooms and supported by third party test results.
      b. Sheets fabricated on exterior openings from commercial quality hot dipped zinc coated

steel complying with ASTM A924 A60. Gauges to be in accordance with manufacturers tested assemblies.
    c. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
    d. Top Edge: Reinforce top of doors with a continuous steel channel extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached and welded in place with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
    e. Hinge Reinforcement: Minimum 7-gauge (3/16") plate 1-1/4" x 9".
  2. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 3 - Extra Heavy-duty.
    b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 2 - Seamless.
    d. Door Face Metal Thickness: 16-gauge, 0.053-inch, minimum.
    e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
  3. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
  4. Door Thickness: 1-3/4 inches, nominal.
  5. Door Face Sheets: Flush.
  6. Door Finish: Factory primed and field finished.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
B. Frame Finish: Factory primed and field finished.
C. Exterior Door Frames: Face welded type.
  1. Classification Level: 3.
  2. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
  3. Frame Metal Thickness: 14-gauge, 0.067-inch, minimum.
  4. Sidelite and Transom Frames: Same material and thickness as door frames.
  5. Weatherstripping: Separate, see Section 08 7100.
D. Interior Door Frames, Non-Fire Rated: Face welded type.
  1. Frame Metal Thickness: 16-gauge, 0.053-inch, minimum.
  2. Sidelite and Transom Frames: Same material and thickness as door frames.
E. Door Frames, Fire-Rated: Face welded type.
  1. Fire Rating: Same as door, labeled.
  2. Frame Metal Thickness: 16-gauge, 0.053-inch, minimum.
  3. Sidelite and Transom Frames: Same material and thickness as door frames.
F. Sound-Rated Door Frames: Face welded type.
  1. Frame Metal Thickness: 16-gauge, 0.053-inch, minimum.
  2. Sidelite and Transom Frames: Same material and thickness as door frames.
G. Tornado-Resistant Door Frames: With same tornado resistance as door; face welded or full profile/continuously welded construction, ground smooth, fully prepared and reinforced for hardware installation.
  1. Frame Metal Thickness: 16-gauge, 0.053-inch, minimum.
  2. Frame Finish: Factory primed and field finished.
H. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding doors.
I. Mullions for Pairs of Doors: Where indicated, mullions to be Fixed, with profile similar to jambs.
J. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
K. Transom Bars: Fixed, of profile same as jamb and head.
L. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

M. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
N. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
O. Frames used with labelled doors shall carry U.L. labels required, as shown on drawings and/or door schedule.
P. Knock down frames shall not be considered as meeting this specification.
Q. Proper reinforcement shall be provided for all hardware where required. Reinforcements, drilling and tapping for mortised applied hardware shall be done at the factory, drilling and tapping shall be done in the field by others.
R. Frame anchors at jambs shall be designed to match wall system they are joining. Jamb anchors at masonry wall openings shall T-buck design and not less than 16-gauge steel spaced not over 16 inches o.c. Jamb anchors at gypsum wallboard partitions shall be welded Z shape and note less than 18 gauge. Provide 18-gauge floor anchors at bottom of all door jambs.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mi18-gauge inch dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
    1. Fire-Rated Frames: Comply with fire rating requirements indicated.

2.06 ACCESSORIES

A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
    1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
    2. Style: Sightproof inverted V blade.
    3. Frame Thickness: 20 gauge.
    4. Louver Free Area: 50 percent.
    5. Manufacturers:
        a. Rockwood Door Louvers.
        b. Dayton Door Louvers.
        c. National Guard Products Door Louvers.
        d. Approved Equal.
        e. Substitutions: See *01 25 00* - Substitution Procedures.
B. Door Vision Lite Frames: Door vision lite frames with glazing securely fastened within door opening.
    1. Size: As indicated on drawings.
    2. Frame Material: 18-gauge, 0.0478-inch, galvanized steel.
    3. Glazing: 1/4-inch thick, tempered glass, in compliance with requirements of authorities having jurisdiction.
C. Glazing: As specified in *Section 08 80 00*, factory installed.
D. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
E. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
F. Frame Anchors: Comply with ANSI/SDI A250.4.
    1. Material:
        a. Exterior Locations: ASTM A653/A653M, A60, Commercial Steel (CS), Type B, metallic-coated steel sheet.
        b. Interior Locations: ASTM A1008/A1008M, Commercial Steel (CS), Type B or ASTM A1011/A1011M, Commercial Steel (CS), Type B.
    2. Jamb Anchors: Suitable for adjoining wall construction.
        a. Quantity:
            1) Frames Up to 7'-6" in Height: Three anchors per jamb.
            2) Frames Over 7'-6" in Height: Three anchors per jamb plus one additional anchor per jamb for each 2 feet of additional height.

3) ICC500 Tornado Resistant Frames: Install quantity, type, and location of anchors at jamb and head to match manufacturer's tested assembly

b. Floor Anchors: Provide 18-gauge floor anchors at each jamb and mullion extending to floor.

c. Jamb anchors at masonry wall openings shall be T-buck design and not less than 16-gauge steel.

d. Jamb anchors at gypsum wallboard partitions shall be welded Z shaped and note less than 18 gauge.

G. Mineral-Fiber Insulation: ASTM C665, Type I.
1. Combustibility: Pass ASTM E136.

H. Shop Primer: Door manufacturer's standard lead and chromate free primer complying with ANSI/SDI A250.10, compatible with field-applied finishes.

I. Fasteners: Hot-dipped galvanized in accordance with ASTM A153/A153M.
1. Power-Actuated Fasteners in Concrete: Type applicable for required installation; corrosive-resistant material.

J. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

K. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Coordinate installation of electrical connections to electrical hardware items.

E. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

F. Install door hardware as specified in *Section 08 71 00*.
1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

G. Comply with glazing installation requirements of *Section 08 80 00*.

H. Touch up damaged factory finishes.

3.04 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

Adjust sound sealed and weather-stripped doors so that seals are fully engaged when door is closed.

DIVISION 08 11 13.1 – WOOD DOORS

Hollow metal doors are preferred. Wood doors shall be considered on a case-by-case basis and the approved design dictates such a need. If special conditions arise, the following design guidelines should be considered. Solid core wood doors with transparent finish in hollow metal frames shall be used at most interior doors including fire doors. Doors shall be pre-fitted and pre-machined at factory for finish hardware. Specify 5" wood stile reinforcement to be provided at hinge, closer, lock and strike locations. Doors shall be 1 ¾" thick and 7'-0" height. Doors shall be 36" wide minimum. Door design will be full flush.

WOOD DOORS: Shall be solid core doors complying with requirements of AWI "Architectural Woodwork Standards (AWS)." Cores shall be solid particle board or staved lumber core except for fire-rated doors which shall have a solid core as required to meet rating requirements. At high traffic doorways, use solid core staved lumber doors or metal doors. Doors shall have a factory finish on both sides and all four edges. Kick plates are recommended for doors in high traffic areas. Kick plates shall be installed on push side only unless directed otherwise.

INTERIOR WOOD DOOR WITH TRANSPARENT FINISH: Shall be AWI Premium Grade with hardwood veneer face. Specify plain sliced white birch or red oak veneer, book match, with Grade AA faces. Rotary cut natural birch is not acceptable due to variations in color.
VISION LIGHTS: All doors at instructional areas will have vision lights. The size and placement of the vision lights shall be determined by the applicable code.

Doors shall have a lifetime warranty. Refer to *DIVISION 01 78 00* - SPECIAL WARRANTIES AND MAINTENANCE AGREEMENTS
DUTCH DOORS: Use Dutch door w/magnetic hold-open in special conditions only and only at the request of MSCS Department of Major Construction.

DIVISION 08 11 13.2 – SPECIAL DOORS

Overhead roll-up doors are acceptable at art rooms and other technical/shop areas. In other areas, overhead roll- up doors should not be used unless no other option is appropriate. Overhead roll-up doors and grills, if used, are to limit access to certain areas of the facility but must not interfere with required egress from occupied spaces.

All overhead doors and grills shall be of metal construction. Discuss with PM if the roll-up door should be motorized where specified.

Roll-up fire doors shall be avoided except when required by the current adopted code or with Owner's approval. Roll-up security grills may be used at serving lines where use of double doors is not practical.

The door at the dish return in the cafeterias shall be stainless steel with the tracks welded to the dish-run backsplash, leaving no gaps. The dish return door shall be specified to be provided by the Kitchen equipment subcontractor.

Exterior sliding glass doors shall not be used.

DIVISION 08 31 00 – ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall- and ceiling-mounted access units.

1.02 RELATED REQUIREMENTS

A. *Section 08 71 00* - Door Hardware: Mortise cylinder and core hardware.
B. *Section 09 90 00* - Painting and Coating; Field paint finish.

1.03 REFERENCE STANDARDS

A. ITS (DIR) - Directory of Listed Products; current edition.
B. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

A. See *Section 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
D. Manufacturer's Installation Instructions: Indicate installation requirements.
E. Manufacturer's qualification statement.

F. Installer's qualification statement.
G. Project Record Documents: Record actual locations of each access unit.

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain access doors for entire Project from one source and by a single manufacturer.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.
C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years' documented experience.

1.06 DELIVERY, STORAGE AND HANDLING

A. Store materials in a locked, weather-tight area. Remove from the locked area only those items to be immediately installed. Products shall be shipped and stored in manufacturers' original, unopened cartons.
B. Size and locate as required to access all valves, switches, junction boxes, and devices requiring service or access.

PART 2 PRODUCTS

2.01 FABRICATION

A. General: Manufacture each access door assembly as an integral unit ready for installation.
B. Steel Access Doors and Frames: Continuous welded construction. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
    1. Exposed flange: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
    2. For gypsum board assemblies or gypsum veneer plaster, furnish frames with edge trim for gypsum board or gypsum base.
C. Locking Devices: Furnish number required to hold door in flush, smooth plane when closed.
    1. For cylinder lock, furnish 2 keys per lock and key all locks alike.

2.02 ACCESS DOORS AND PANELS ASSEMBLIES

A. Wall-Mounted Units:
    1. Location: As indicated on drawings and otherwise required to access equipment, valves, junction boxes, and other areas requiring maintenance.
    2. Panel Material: Steel, hot-dipped zinc or zinc-aluminum-alloy coated with prime coat finish.
    3. Size: 8 by 8 inches minimum or larger size as required for access to equipment.
    4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
    5. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
B. Wall-Mounted Units in Wet Areas:
    1. Location: As indicated on drawings and otherwise required to access equipment, valves, junction boxes, and other areas requiring maintenance.
    2. Panel and Frame Material: Zinc-aluminum-alloy coated. with prime coat finish.
    3. Size: 8 by 8 inches minimum or larger size as required for access to equipment.
    4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
C. Fire-Rated Insulated Wall-Mounted Units:
    1. Location: As indicated on drawings and otherwise required to access equipment, valves, junction boxes, and other areas requiring maintenance.
    2. Wall Fire-Rating: As indicated on drawings.
    3. Panel Material: Steel.
    4. Size: 8 by 8 inches minimum or larger size as required for access to equipment.
    5. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.
D. Ceiling-Mounted Units:
    1. Location: As indicated on drawings and otherwise required to access equipment, valves, junction boxes, and other areas requiring maintenance.
    2. Panel Material: Steel.
    3. Size - Lay-In Grid Ceilings: To match module of ceiling grid.
    4. Size - Other Ceilings: 12 by 12 inches.
    5. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.03 WALL AND CEILING MOUNTED ACCESS UNITS

A. Manufacturers:
   1. Basis of Design: Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
   2. ACUDOR Products Inc: www.acudor.com/#sle.
   3. Babcock-Davis: www.babcockdavis.com/#sle.
   4. Best Access Doors: www.bestaccessdoors.com/#sle.
   5. Milcor, Inc: www.milcorinc.com/#sle.
   6. Nystrom, Inc: www.nystrom.com/#sle.
   7. Approved Equal.
   8. Substitutions: See *01 25 00* - Substitution Procedures.

B. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
   1. Material: Steel.
   2. Style: Recessed door panel for infill with wall/ceiling finish.
   3. Door Style: Single thickness with rolled or turned in edges.
   4. Frames: 16-gauge, 0.0598-inch minimum thickness.
   5. Door Panels to Receive Wall/Ceiling Finish: Surface recessed 5/8 inch back from wall face.
   6. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
      a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
   7. Aluminum Finish: Natural brushed.
   8. Hardware:
      a. Hardware for Fire-Rated Units: As required for listing.
      b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
      c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.
      d. Number of Locks/Latches Required: As recommended by manufacturer for unit size.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

DIVISION 08 33 13 – COILING COUNTER DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire-rated coiling counter doors and operating hardware.

B. Electric motor operation; wiring from electric circuit disconnect to operator to control station.

1.02 RELATED REQUIREMENTS

A. *Section 08 71 00* - Door Hardware: Cylinder cores and keys.

B. *Section 26 05 83* - Wiring Connections: Power to disconnect.

1.03 REFERENCE STANDARDS

A. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

1.04 SUBMITTALS

A. See *Section 01 30 00* - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish. Include data on electrical operation.
C. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.
D. Samples: Submit two slats, 4 inch long, illustrating shape, color and finish texture.
E. Manufacturer's Instructions: Indicate installation sequence and installation, adjustment, and alignment procedures.
F. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.
G. Project Record Documents: Include as-built electrical diagrams for electrical operation and connection to fire alarm system.

1.05 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Coiling Counter Doors:
1. McKeon: www.mckeondoor.com
2. Alpine Overhead Doors, Inc: www.alpinedoors.com.
3. Overhead Door Company: www.overheaddoors.com/#sle
4. C.H.I. Overhead Doors: www.chiohd.com/#sle.
5. Raynor Garage Doors: www.raynor.com/#sle.
6. Clopay Corporation: www.clopaydoor.com/#sle
7. Approved Equal.
8. Substitutions: See *01 25 00* - Substitution Procedures.

B. Coiling Counter Doors, Manually Push-up Operated:
1. Basis of Design: McKeon; Model CS3000-PP-SS: www.mckeondoor.com

C. Coiling Counter Doors, Hand-Crank Operated:
1. Basis of Design: McKeon; Model CS3000-HK-SS: www.mckeondoor.com

D. Coiling Counter Doors, Motor Operated:

E. Coiling Counter Fire and Smoke Rated Shutters:Hand-Crank Operated
1. Basis of Design: McKeon; Auto-Set System Model CFS-HK-PC: www.mckeondoor.com
2. Approved Equal.

F. Coiling Counter Fire and Wind Rated Shutters ~~Doors~~:
1. Basis of Design: McKeon; Auto-Set System Model SS-500F: www.mckeondoor.com/sle#

2.02 COILING COUNTER DOOR, MANUALLY PUSH-UP OPERATED

A. Materials:
1. Curtain: Shall be assembled of 22-gauge stainless steel interlocking slats, cold rolled. Slats shall have endlocks locking each end of alternate slats to act as a wearing surface and maintain slat alignment.
   a. Slats: Shall be of a cross section not less than 1½” wide by ½" deep.
2. Bottom Bar: Shall consist of a single stainless-steel angle not less than 1½” x 1½” formed to fit slats. Provide slide locks with hasps on both jambs to allow for locking.
3. Guides: Each guide assembly shall be fabricated of a minimum 1/8” stainless steel angles and channels formed to a box type configuration.
4. Mounting Brackets: Fabricated of hot rolled 1/8” stainless steel plate minimum, brackets shall be provided to house ends of the counterbalance barrel assembly.
5. Hood: Shall be provided to entirely enclose curtain and counterbalance barrel assembly. Hood shall be fabricated 22-gauge stainless steel and designed to match brackets. Top and bottom shall be bent and reinforced for stiffness.
6. Counterbalance Assembly: Counter shutters shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.
7. Manual Operation: Counter shutters shall be designed so that it may be manually opened

and closed. The counter shutter shall not require more than 35 pounds of operational force to move the shutter in either direction.

8. Finish: After completion of fabrication, clean all metal surfaces to remove dirt. All steel components shall receive two coats of rust inhibitive primer. All exposed stainless-steel components shall be of type 304 with a No. 4 polished finish.

2.03 COILING COUNTER DOOR, HAND CRANK OPERATED

A. Materials:

1. Curtain: Shall be assembled of 22-gauge stainless steel interlocking slats, cold rolled. Slats shall have endlocks locking each end of alternate slats to act as a wearing surface and maintain slat alignment.
   a. Slats: Shall be of a cross section not less than 1½" wide by ½" deep.
2. Bottom Bar: Shall consist of a single stainless-steel angle not less than 1½" x 1½" formed to fit slats. Provide slide locks with hasps on both jambs to allow for locking.
3. Guides: Each guide assembly shall be fabricated of a minimum 1/8" stainless steel angles and channels formed to a box type configuration.
4. Mounting Brackets: Fabricated of hot rolled 1/8" stainless steel plate minimum, brackets shall be provided to house ends of the counterbalance barrel assembly.
5. Hood: Shall be provided to entirely enclose curtain and counterbalance barrel assembly. Hood shall be fabricated 22-gauge stainless steel and designed to match brackets. Top and bottom shall be bent and reinforced for stiffness.
   Counterbalance Assembly: Counter shutters shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.
6. Hand Crank Operator: Counter shutter shall be provided with a compact reduction geared unit designed as an integral part of the assembly. The hand crank mechanism shall not require more than 35 pounds of operational force to move the counter shutter in either the open or close position.
7. Finish: After completion of fabrication, clean all metal surfaces to remove dirt. All steel components shall receive two coats of rust inhibitive primer. All exposed stainless-steel components shall be of type 304 with a No. 4 polished finish.

2.04 COILING COUNTER FIRE AND SMOKE RATED DOOR, HAND CRANK OPERATED

A. MATERIALS

1. Curtain: Shall be assembled of stainless-steel interlocking slats, cold rolled. Slats shall have endlocks locking each end of alternate slats to act as a wearing surface and maintain slat alignment. Curtain shall be 22-gauge minimum or gauge required by UL, WH or FM whichever is greater.
2. Slats: Shall be of a cross section not less than 1½" wide by ½" deep.
3. Bottom Bar: Shall consist of a single stainless-steel angle not less than 1½" x 1½" formed to fit slats. Bottom bar shall be provided with slotted holes to allow for thermal expansion.
4. Guides: Each guide assembly shall be fabricated of a minimum 1/8" stainless steel angles and channels formed to a box type configuration. Guides shall be provided with slotted holes to allow for thermal expansion.
   a. Provide internal, fully concealed UL Classified smoke seals located within each guide assembly. Externally mounted smoke seals shall not be acceptable.
   b. Drywall Applications: Provide steel support tubes designed and constructed with a slip joint at the top to allow for thermal expansion.
5. Mounting Brackets: Fabricated of hot rolled 1/8" steel plate minimum, brackets shall be provided to house ends of the counterbalance barrel assembly.
6. Hood: Shall be provided to entirely enclose curtain and counterbalance barrel assembly. Hood shall be fabricated 22-gauge stainless steel and designed to match brackets. Top and bottom shall be bent and reinforced for stiffness.
   a. Provide UL Classified lintel smoke seals.
7. Counterbalance Assembly: Fire shutters shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting

blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.

8. Hand Crank Operator: Fire shutter shall be provided with a compact reduction geared unit designed and built by the shutter manufacturer. High efficiency reduction gearing running in an oil bath, shall be furnished together with a centrifugal governor and a fail-safe magnetic release device, completely housed to protect against damage, dust and moisture.
9. Self-Closing Mechanism: The fire shutter is to be designed with a centrifugal governor as an integral part of the operator's construction. The automatic release mechanism shall be activated by a fusible link, smoke detector or fire alarm. When activated the shutter is released and begins to close due to gravitational force. The speed of the shutter is governed by a centrifugal governor, designed to match the normal operating speed of the shutter, at a rate of not greater than 9" per second or less than 6" per second.
10. Magnetic Release with 10 Second Time Delay: A fail-safe magnetic release device shall be built into the operator as an integral part of the release mechanism. When power is interrupted to the release mechanism by the smoke detector or fire alarm, the shutter shall begin to self-close. In the event of power failure, the time delay shall prevent the fire shutter from closing for a period of 10 seconds. Once the 10 seconds have lapsed, the fire shutter shall self-close. Once power has been restored to the release mechanism the automatic reset time delay as well as the fire shutter shall automatically reset themselves.
11. Easy Trip Test Feature: The fire shutter shall be designed so that it may be trip tested simply by cutting power to the operator. By turning the power switch off, the shutter shall self-close. Once the fire shutter has satisfactorily closed, it shall be reset simply by turning the power back on. No ladders or tools shall be needed to reset the shutter or the time delay unit.
12. Finish: After completion of fabrication, clean all metal surfaces to remove dirt. and chemically treat to provide for powder coat adhesion. Provide powder coat finish of color as selected by architect from manufacturer’s standard RAL powder coat selection chart.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.
B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
E. Coordinate installation of electrical service with Section 26 0583.
F. Complete wiring from disconnect to unit components.
G. Complete wiring from fire alarm system.
H. Test shutter closing sequence when activated by the building's fire alarm system. Reset shutter after successful test.
I. Coordinate installation of sealants and backing materials at frame perimeter as specified in *Division 07 92 00*.
J. Install perimeter trim as indicated.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.
B. Maximum Variation From Plumb: 1/16 inch.
C. Maximum Variation From Level: 1/16 inch.
D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

A. Clean installed components.
B. Remove labels and visible markings.

DIVISION 08 33 23 – OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire-rated coiling doors and operating hardware.
B. Electric motor operation: Wiring from electric circuit disconnect to operator to control station.

1.02 RELATED REQUIREMENTS

A. *Division 07 92 00* - Joint Sealants: Sealing joints between frames and adjacent construction.
B. *Division 08 71 00* - Door Hardware: Cylinder cores and keys.
C. *Division 26 05 83* - Wiring Connections: Power to disconnect.
D. *Division 28 46 00* - Fire Detection and Alarm: Fire alarm interconnection.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide general construction, electrical equipment, and component connections and details.
C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
D. Samples: Submit two slats, in size illustrating shape, color and finish texture.
E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.
F. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years' documented experience.
C. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.
D. Subcontractor Qualifications:
    1. Contract with or employ a subcontractor or company which specializes in the Work herein specified.
    2. Contract with or employ a subcontractor or company which has:
        a. Five (5) years continuous and successful experience performing the Work and related tasks herein specified.
        b. Completed ten (10) projects of similar size and scope.
        c. An adequate number of skilled workmen who are trained and experienced in the necessary crafts and methods needed for a proper performance of the Work.
        d. Adequate and capable supervision who can ensure that all workmen are familiar with the requirements herein specified and are familiar with the requirements of the manufacturer whose materials or products will be installed in the Work.
    3. Been licensed or approved by the pertinent manufacturer.
E. Fire and Smoke Rated Assemblies: Provide all doors with fire and smoke resistance rating required to comply with governing regulations which are inspected, tested, listed and labeled by UL, WH or FM and complying with NFPA 80 for class of opening. Provide units tested in accordance with the requirements of UL 10B, UL 1784, NFPA 252, ASTM E-152. Provide testing laboratory label permanently fastened to each fire and smoke door assembly.
F. Regulatory Requirements:
    1. Comply with applicable FEMA requirements as well as laws, codes, ordinances and regulations of federal, state and municipal authorities having jurisdiction.

2. Listed under a certified Code Compliance Research Report in accordance with the applicable sections of the International Building Code.

G. Manufacturer Requirements: Door manufacturer shall have been in the business of and have experience in manufacturing the type of product covered under this specification section as well as giving credible service for a minimum of five (5) years. Provide list of at least ten (10) completed projects which include the products covered under this section.

H. Operational Cycle Life: Tornado and hurricane resistant coiling doors shall be designed and constructed for a minimum 10,000 operating cycles for the life of the door assembly. Cycles shall be verifiable by a non-resettable cycle counter located within the door's motor operator control panel.

1.06 WARRANTY

A. Door Warranty: Provide two (2) year, 10,000 Cycle Warranty signed by the manufacturer and installer agreeing to repair or replace work which has failed as a result of defects in materials or workmanship. Upon notification within the warranty period, such defects shall be repaired at no cost to the Owner.

1.07 PRODUCT HANDLING

A. Deliver materials or products to the site of the Work at the optimum time in the construction schedule to minimize handling and storage.
   1. If storage becomes necessary, store only as directed or recommended by the pertinent manufacturer.
   2. Prevent exposure to extreme heat and humidity.
   3. Handle products prior to installation and during installation only as directed, recommended or approved by the pertinent manufacturer.
   4. Lift using appropriate tools or equipment at the locations directed, recommended or approved by the pertinent manufacturer.

B. Deliver materials or products to the site of the Work in their original unopened packages bearing the name of the manufacturer, the brand, and other pertinent information required to properly identify the materials or products.

C. Do not install, erect or apply any materials or products that have been damaged by improper storage or handling techniques.

D. Immediately remove any and all damaged materials or products for the Site of the Work and replace with new at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Overhead Coiling Doors:
   1. McKeon Door; www.mckeondoor.com.
   2. Alpine Overhead Doors, Inc: www.alpinedoors.com.
   3. C.H.I. Overhead Doors: www.chiohd.com/sle.
   4. Clopay Building Products: www.clopaydoor.com/sle.
   5. Overhead Door Corporation: www.overheaddoor.com/#sle.
   6. Raynor Garage Doors: www.raynor.com/#sle.
   7. The Cookson Company: www.cooksondoor.com.
   8. Approved Equal.
   9. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Overhead Coiling Doors – Fire and Smoke Rated, Hand-Crank Operated:
   1. Basis of Design: McKeon Door; Auto-Set Model FSFD-HK-G: www.mckeondoor.com.

C. Overhead Coiling Doors – Insulated, Hand Chain Operated:
   1. Basis of Design: McKeon Door; Model ClimateGuard IS3022-HC-SS/PC: www.mckeondoor.com.

D. Overhead Coiling Doors, Tornado and Hurricane Resistant + Fire Rated:
   1. Basis of Design: McKeon Door; Model SafeSpace SS500F-PC: www.mckeondoor.com.

2.02 OVERHEAD COILING DOORS - FIRE AND SMOKE RATED

A. Curtain: Shall be assembled of G90 galvanized steel interlocking slats. Slats shall have endlocks locking each end of alternate slats to act as a wearing surface and maintain slat alignment. Curtain shall be 22-gauge minimum or gauge required by UL, WH or FM whichever is greater.
   1. Slats: Shall be of a cross section not less than 3" wide by 7/8" deep.

B. Bottom Bar: Shall consist of two (2) angles, each not less than 2" x 2" x 1/8" steel formed to fit slats. Bottom bar shall be provided with slotted holes to allow for thermal expansion.
C. Guides: Each guide assembly shall be fabricated of a minimum 3" x 3" steel support angle or tube, a 2" x 3" inner guide angle and a 3" x 3" outer guide angle. Support tubes shall be constructed with a slip joint at the top to provide for thermal expansion and guide angles shall be provided with slotted holes to allow for thermal expansion.
    1. Provide internal, fully concealed UL Classified smoke seals located within each guide assembly. Externally mounted smoke seals shall not be acceptable.
D. Mounting Brackets: Fabricated of hot rolled 3/16” steel plate minimum, brackets shall be provided to house ends of the counterbalance barrel assembly.
E. Hood: Shall be provided to entirely enclose curtain and counterbalance barrel assembly. Hood shall be fabricated 22-gauge G90 galvanized steel and designed to match brackets. Top and bottom shall be bent and reinforced for stiffness.
F. Provide UL Classified lintel smoke seals.
G. Counterbalance Assembly: Fire doors shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.
H. Hand Crank Operator: Fire doors shall be provided with a compact reduction geared unit designed and built by the door manufacturer. High efficiency reduction gearing running in an oil bath, shall be furnished together with a centrifugal governor and a fail-safe magnetic release device, completely housed to protect against damage, dust and moisture.
I. Self-Closing Mechanism: The fire door is to be designed with a centrifugal governor as an integral part of the operator's construction. The automatic release mechanism shall be activated by a fusible link, smoke detector or fire alarm. When activated the door is released and begins to close due to gravitational force. The speed of the door is governed by a centrifugal governor at a rate of not greater than 9" per second or less than 6" per second.
J. Magnetic Release with 10 Second Time Delay: A fail-safe magnetic release device shall be built into the operator as an integral part of the release mechanism. When power signal is interrupted to the release mechanism by the smoke detector or fire alarm, the release device shall prevent the door from self-closing for period up to 10 seconds, once the 10 seconds have lapsed the door shall begin to self-close.
K. Easy Trip Test Feature: The fire door shall be designed so that it may be trip-tested simply activating the magnetic release device. By activating the magnetic release device, the door shall delay for 10 seconds and then begin to self-close. Once the fire door has satisfactorily closed, it shall be simply reset by pulling the reset cable. No ladders or tools shall be needed to reset the door or the magnetic release mechanism.
L. Finish: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for paint adhesion. Curtain assembly is to receive a prime coat finish of .2 mils of epoxy primer and .8 mils of polyester paint.

2.03 OVERHEAD COILING DOORS – INSULATED

A. Legend:
    1. SS: Stainless steel.
    2. PC: Powder-coated Steel
B. Curtain
    1. SS: Shall be assembled of 22-gauge front and back panel stainless steel interlocking slats. Slats shall have endlocks locking each end of all alternate slats to act as a wearing surface and maintain slat alignment. The void of the curtain slats shall be filled with foamed-in-place polyurethane insulation and the front and back panel slats must have a positive interlock. Slats with snap-in back panels are not acceptable.
        a. Slats: Shall be of a cross section not less than 3” wide by 1” deep.
    2. PC: Shall be assembled of 22-gauge front and back panel G90 galvanized steel interlocking slats. Slats shall have endlocks locking each end of all alternate slats to act as a wearing surface and maintain slat alignment. The void of the curtain slats shall be filled with foamed-in-place polyurethane insulation and the front and back panel slats must have

a positive interlock. Slats with snap-in back panels are not acceptable.
    a. Slats: Shall be of a cross section not less than 2-5/8” wide by 5/8” deep.

C. Bottom Bar
    1. SS: Shall consist of two (2) angles, each not less than 2" x 2" x 1/8" stainless steel formed to fit slats.
    2. PC: Shall consist of two (2) angles, each not less than 2" x 2" x 1/8" steel formed to fit slats. Provide neoprene astragal to act as a weather seal against air infiltration and slide locks with hasps on both jambs to allow for locking.

D. Guides
    1. SS: Each guide assembly shall be fabricated of a minimum 3" x 3" stainless steel support angle, a 2" x 3" inner guide stainless steel angle and a 3" x 4" outer guide stainless steel angle. Provide Neoprene weather seals extending the full height of both guides.
    2. PC: Each guide assembly shall be fabricated of a minimum 3" x 3" steel support angle, a 2" x 3" inner guide angle and a 3" x 3" outer guide angle. Provide neoprene weather seals extending the full height of both guides.

E. Mounting Brackets
    1. SS: Fabricated of hot rolled 3/16” stainless steel plate minimum, brackets shall be provided to house ends of the counterbalance barrel assembly.
    2. PC: Fabricated of hot rolled 3/16” steel plate minimum, brackets shall be provided to house ends of the counterbalance barrel assembly.

F. Hood
    1. SS: Shall be provided to entirely enclose curtain and counterbalance barrel assembly. Hood shall be fabricated 22-gauge stainless steel and designed to match brackets. Top and bottom shall be bent and reinforced for stiffness. Provide internal neoprene air baffle to minimize air infiltration at the head.
    2. PC: Shall be provided to entirely enclose curtain and counterbalance barrel assembly. Hood shall be fabricated 22-gauge G90 galvanized steel and designed to match brackets. Top and bottom shall be bent and reinforced for stiffness. Provide internal neoprene air baffle to minimize air infiltration at the head.

G. Counterbalance Assembly: Coiling insulated service door shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.

H. Hand Chain Operator: Coiling insulated service door shall be provided with a gear reduction mechanism designed and built by the door manufacturer. The gear reduction mechanism shall not require more than 35 pounds of operational force to move the coiling insulated service door in either direction.

I. Finish:
    1. SS: After completion of fabrication, clean all metal surfaces to remove dirt. All steel components shall receive two coats of rust inhibitive primer. All exposed stainless-steel components shall be of type 304 with a No. 4 polished finish.
    2. PC: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for powder coat adhesion. Provide powder coat finish of color as selected by architect from manufacturer’s standard RAL powder coat selection chart.

2.04 OVERHEAD COILING DOORS - TORNADO AND HURRICANE RESISTANT + FIRE RATED

A. Manufacturer: Tornado and hurricane resistant coiling doors assembly shall be tested, listed and labeled by an IAS accredited nationally recognized testing laboratory, approved for use in FEMA 361 and ICC 500-2020 safe rooms and storm shelters.

B. Materials:
    1. Curtain: Shall be assembled of G90 galvanized steel interlocking slats. Curtain shall be formed of slat profile sections of gauge as required to sustain the minimum required design wind pressure.
        a. Slat cross section shall not be less than 3” wide by 1-1/2” deep.
    2. Bottom Bar: Shall consist of a double 2” x 3” structural steel angle assembly formed to fit and engage the curtain assembly.

3. Guides: Each guide assembly shall be fabricated of structural steel support angles no greater 4" x 4 " and guide retaining angles of a minimum 6" depth to retain curtain in the guides under the design wind pressure and impact forces specified.
    a. Provide internally concealed UL Classified smoke seals located within each guide assembly. Externally mounted smoke seals shall not be acceptable.
4. Mounting Brackets: Fabricated of hot rolled 3/16” minimum steel plates, brackets shall be provided to house ends of the counterbalance barrel assembly.
5. Hood: Shall be provided to entirely enclose coiled curtain and counterbalance barrel assembly. Hood shall be fabricated 22-gauge G90 galvanized steel, designed and formed to match brackets. Top and bottom shall be bent and reinforced to provide for proper stiffness.
    a. Provide internally concealed UL Classified smoke seals located within the hood assembly. Externally lintel mounted smoke seals shall not be acceptable.
6. Counterbalance Assembly: Coiling doors shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.
7. Electric Motor Operator: Door shall be provided with a compact power unit designed and laboratory listed by the door manufacturer. Operator shall be equipped with an adjustable screw-type limit switch to break the circuit at termination of travel. High efficiency planetary gearing running in an oil bath, shall be furnished together with a centrifugal governor, magnetic operated brake and a fail-safe magnetic release device, completely housed to protect against damage, dust and moisture. An efficient overload protection device, which will break the power circuit and protect against damage to the motor windings shall be integral with the unit. Operator is to be housed in a NEMA type 1 enclosure.
    a. Motor: Shall be intermediate duty, thermally protected, ball bearing type with a Class A or better insulation. Horsepower of motor is to be 1/2hp minimum or of manufacturer's recommended size, whichever is greater.
    b. Starter: Shall be size "0" magnetic reversing starter, across the line type with mechanical and electrical interlocks, with 10-amp continuous rating and 24-volt control circuit.
    c. Reducer: Planetary gear type, 80% efficiency minimum.
    d. Cycle Counter: Non-resettable operational cycle counter.
8. Control Stations: Each fire rated tornado and hurricane storm door shall be provided with flush mount three position push button control station marked open, close and stop that is active during normal conditions and as long as there is no main power failure to the motor operator.
9. Master Control Station: Provide a single master control station that can simultaneously activate all of the fire rated tornado and hurricane storm doors in the facility to the emergency closed or open positions. The master control station shall remain operable as long as there is no main power failure to the door's motor operators.
10. FS Self-Closing Mechanism: The fire rated tornado and hurricane storm door with automatic release mechanism shall be activated by a fusible link, fire alarm, emergency alarm or power failure. When activated the door shall be released and begin to self-close under gravitational force. The speed of the door shall be governed by a centrifugal governor at a rate of not greater than 9" per second or less than 6" per second.
11. Magnetic Release with 10 Second Time Delay: A fail-safe magnetic release device shall be built into the operator as an integral part of the release mechanism. When power is interrupted to the release mechanism by the facility’s smoke detection or fire alarm system, the door shall begin to self-close. In the event of power failure, the time delay shall prevent the fire door from closing for a period of 10 seconds. Once the 10 seconds have lapsed, the fire door shall self-close.
12. Emergency and Fire Alarm Activation: Upon activation by the facility’s alarm system the fire rated hurricane and tornado storm door shall immediately self-close to the fully closed position. Once the emergency or fire alarm condition has been cleared and main power has

been restored, the door shall power itself back to the fully open position.

13. Emergency Manual Operation: In the event of power failure, a time delay shall prevent the door assembly from closing for a period of 10 seconds. Once the 10 seconds have lapsed, the door assembly shall immediately self-close. The door assembly shall be equipped with an emergency hand chain that shall be operable during main power failure lasting up to six hours, as long as there is no alarm condition present. After the six hours have lapsed, the door shall automatically self-close and remain in the closed position until the main power has been restored. Upon activation of the facility's emergency alarm system the door assembly shall immediately self-close to the fully closed position and the emergency hand chain shall become inoperable. Once the emergency alarm condition has been cleared and main power has been restored, the door shall automatically power itself back to the fully open position and the emergency hand chain will now become operable.
14. Obstruction Sensing Safety Edge: The obstruction sensing safety edge shall be programable to either stop or reverse upon coming in contact with an obstruction during the close cycle of the door. During normal operation the obstruction sensing safety edge shall remain active and operable as long as there is no main power failure to the motor operator. During an alarm condition, the obstruction sensing safety edge shall reverse a maximum of three times and then comes to contact on the obstruction until the obstruction has been removed and the door returns to the fully closed position. During main power failure, if the obstruction sensing safety edge comes in contact with an obstruction during the self-closing mode the door shall stop and remain in contact with the obstruction until it is removed and the door can continue to the fully closed position.
15. True Test Panel: Fire rated tornado and hurricane storm doors shall be provided with a True Test panel. The test panel shall be designed so that it simulates an actual emergency alarm condition and activates all of the doors to self-close to the fully closed position. Once all of the doors have satisfactorily closed and the test panel has been reset, all of the doors shall automatically power themselves back to the fully open and alarm ready reset condition. Only one test panel shall be required to test all the fire rated tornado and hurricane storm doors on this project simultaneously.
16. Finish: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for powder coat adhesion. Provide powder coat finish of color as selected by Architect/Engineer from manufacturer's standard RAL powder coat selection chart.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that opening sizes, tolerances and conditions are acceptable.
B. Verify that all the required and necessary preparatory work has been properly performed and that all conditions affecting the installation are acceptable.

3.02 INSTALLATION

A. Install fire-rated doors in accordance with NFPA 80.
B. Coordinate installation of electrical service with Section 26 0583.
C. Complete wiring from disconnect to unit components.
D. Complete wiring from fire alarm system.
E. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 9200.
F. Install enclosure and perimeter trim.
G. Coordinate installation with adjacent work to ensure proper clearances and allow for proper maintenance.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.
B. Maximum Variation From Plumb: 1/16 inch.
C. Maximum Variation From Level: 1/16 inch.
D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet straight edge.

3.04 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.
B. Instruct the Owner's personnel in proper operating and maintenance procedures.

3.05 CLEANING

A. Clean installed components.
B. Remove labels and visible markings.
C. Touch-up damaged coatings and finishes and repair minor damage if approved by the Architect/Engineer.

DIVISION 08 33 43 – FIRE AND SMOKE-RATED CURTAIN SHUTTERS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Provide all materials, labor, equipment and services necessary to furnish, deliver and install all work under this section as shown on the contract documents, specified herein, and as specified by the job conditions.

1.02 DESCRIPTION

A. Related work specified elsewhere:
   1. *Division 05 50 00* - Metal Fabrications.
   2. *Division 06 10 00* - Rough Carpentry.
   3. *Section 08 31 00* - Access Doors and Panels.
   4. *Section 09 90 00* - Painting and Coating.
   5. Division 26 - Electrical.

1.03 SUBMITTALS

A. Procedures: Furnish submittals in accordance with the general requirements specified.
B. Shop Drawing: Furnish shop drawings for architect's approval. Include elevations, sections, and details indicating dimensions, materials, finishes, conditions for anchorage and support of each fire and smoke rated curtain.
C. Product Literature: Submit manufacturer's technical literature describing the product to be used under this section.
D. Maintenance and Operating Manuals: Furnish complete manuals describing the materials, devices and procedures to be followed in operating and maintaining all of the fire and smoke-related curtains under this section. Include manufacturer's brochures and parts lists describing the actual materials used in the product.
E. Product Approval Reports: Submit copy of manufacturer's Listing Report and Authorization To Mark clearly detailing the description of product, fire endurance test method, test results and test conclusions of the test criteria as conducted and witnessed by a United States accredited testing laboratory such as Underwriters Laboratories (UL) or Intertek-Warnock Hersey (Intertek). Testing agency's Listing Report shall clearly state that the fire and smoke rated curtains have been tested and approved to the standards and criteria of UL 10B (90 minutes) with Hose Stream and UL 1784 Smoke & Draft rating without the use of an artificial bottom seal.

1.04 QUALITY ASSURANCE

A. Fire & Smoke Rated Assemblies: Provide all curtain shutters with fire and smoke resistance rating required to comply with governing regulations which are inspected, tested, listed and labeled by UL or Intertek and complying with NFPA 80 for class of opening. Provide units tested, approved and labeled under the UL 10B with Hose Stream and UL 1784 standards. Provide testing laboratory label permanently affixed to each fire curtain bottom bar assembly as evidence of product compliance in accordance with the requirements outlined under NFPA 80.
B. Oversize Assemblies: Where units exceed the testing laboratory's label size, an Oversize Certificate label issued by either UL or Intertek shall be provided and permanently affixed to each fire curtain shutter bottom bar assembly as evidence of product compliance. Oversize assemblies requiring the joining of curtain sections together on site by the installer must require documented field certification by UL or Intertek.
C. Electric Motor Drives and Control Equipment: Tested, listed and labeled under standards UL 325. Provide testing laboratory label permanently affixed to each fire curtain control panel as evidence of product compliance.
D. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances and regulations of federal, state and municipal authorities having jurisdiction.
E. Product Labeling: Provide a fire and smoke rating label from an accredited independent testing laboratory, such as UL or Intertek in accordance NFPA 80, Listed and Labeled Products.

The label shall be permanently affixed to the bottom bar of the product so that it is readily visible and convenient for identification by the AHJ after installation of the assembly. At a minimum the fire and smoke rating label shall indicate product compliance with all of the appropriate test standards and performance requirements as indicated in NFPA 80.

1.05 DELIVERY, STORAGE AND HANDLING

A. General: Deliver and store materials in manufacturer's original packaging, labeled to show name, brand and type. Store materials in a protected dry location off the ground in accordance with manufacturer's instructions.

1.06 WARRANTY

A. Fire & Smoke Rated Curtain Shutter Warranty: Provide Two (2) Year Warranty signed by the manufacturer and installer agreeing to repair or replace work which has failed as a result of defects in materials or workmanship. Upon notification within the warranty period, such defects shall be repaired at no cost to the owner.

PART 2 PRODUCTS

2.01 FIRE & SMOKE RATED CURTAIN SHUTTERS

A. Manufacturer:
   1. Basis of Design: Fire and smoke rated curtain shutters shall be the FireFighter® Series model D400 as manufactured by McKEON: www.mckeondoor.com.
   2. Approved Equal.
   3. Substitutions: See *Section 01 60 00* - Product Requirements.

2.02 MATERIALS

A. Assembly Design: Shall be designed requiring a single motor power drive to operate the opening curtain shutter. Fire and smoke rated assemblies requiring more than one motor drive unit to operate the curtain assembly and any overlapping curtain sections are not acceptable.

B. Curtain: Shall be manufactured of 90 minute UL 10B fire rated textile curtain, consisting of a fire and smoke resistant light weight textile composition designed to coil and store into a compact housing. Curtain weight shall be no greater than 0.3 pounds per square foot.

C. Bottom Bar: Shall consist of a double angle assembly formed to fit the curtain, provide stiffness, limit deflection and allow for a tight fitting closure. Bottom bar shall be designed of adequate size and weight to keep the curtain fully extended, taut and level during self-closing while preventing deflection caused by the building's normal air pressure currents.

D. Guide Assemblies: Each guide assembly shall be fabricated of a steel mounting adjustment angle or tube with integral pressure retaining side guides. The side guides are to be designed and fitted with internally concealed UL approved and classified smoke seals.

E. Endplates: Fabricated of minimum 3/16" thick steel endplates provided to house and support ends of the barrel assembly.

F. Hood: Shall be provided to entirely enclose the curtain and barrel assembly. Hood shall be fabricated of minimum 22 gauge G90 galvanized steel formed to match brackets. Top and bottom shall be bent and reinforced for stiffness. Hood shall be fitted with UL approved and classified smoke seals.

G. Barrel Assembly: Fabricated of structural quality carbon steel seamless pipe of sufficient size and diameter to house operating motor drive, support the curtain assembly and limit horizontal deflection of the fire and smoke rated curtain shutter assembly.

H. Single Motor Drive Unit: Fire and smoke rated curtain shutters shall be powered by a single motor drive design including gearbox assembly, electromechanical distance travel limit switches all linked to an internal electromagnetic brake which allows the draft curtain to operate under normal and fire ready conditions. Motor drive units shall be listed and labeled to test standard UL 325.
   1. Control Station: Provide flush mount key switch control station marked open, close and stop.

I. Fail-Safe Release Device: A fail-safe release device shall be built into the motor drive unit as an integral part of the release mechanism. When power is interrupted to the release mechanism by an alarm condition, the fire and smoke rated curtain shutters shall automatically self-close. In the event of power failure a time delay shall prevent the fire and smoke curtain shutters from closing for a period of 30 minutes, unless there is an alarm condition at which point the fire and smoke rated curtain shutters shall immediately self-close. Once power has been restored and the alarm

condition has been cleared, the release mechanism shall automatically reset and the fire and smoke rated curtain shutters shall automatically power themselves back to the fully open position and normal operating condition.

J. True Test Panel: Fire and smoke rated curtain shutters shall be provided with a True Test panel. A single True Test panel shall activate and automatically reset all the fire and smoke rated curtain shutters on the project. When activated to close via the True Test panel, the fire and smoke rated curtain shutters shall self-close under gravity, not power, in accordance with the requirements outlined under NFPA 80 Standard for Fire Doors and Other Opening Protectives.

K. Finish: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for paint adhesion. Hood, guides and bottom bar shall be of McKEON Sterling Gray finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces and field conditions to which this work is to be performed and notify architect if conditions of surfaces exist which are detrimental to proper installation and timely completion of work.

B. Verify all dimensions taken at job site affecting the work. Notify the architect in any instance where dimensions vary.

C. Coordinate and schedule work under this section with work of other sections so as not to delay job progress.

3.02 INSTALLATION

A. Perform installation using only factory approved and certified representatives of the fire and smoke curtain shutter manufacturer.

B. Install fire and smoke curtain shutter assemblies at locations shown in perfect alignment and elevation, plumb, level, straight and true.

C. Adjust fire and smoke curtain shutter installation to provide uniform clearances and smooth non-binding operation.

D. Install wiring in accordance with applicable local codes and the National Electrical Code Standard. Materials shall be UL listed.

E. Test fire and smoke curtain shutter closing sequence when activated by the building's fire alarm system. Reset fire and smoke curtain after successful test.

3.03 PROTECTION AND CLEANING

A. Protect installed work using adequate and suitable means during and after installation until accepted by owner.

B. Remove, repair or replace materials which have been damaged in any way.

C. Clean surfaces of grime and dirt using acceptable and recommended means and methods.

DIVISION 08 41 00 – ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

WINDOWS & STOREFRONT: Shall be commercial grade type fabricated from aluminum extrusions of not less than 0.062" thickness for main frame and sash thickness. Thermal break construction shall be used. Aluminum sub sills with waterproof edges shall be used and attachment system that eliminates penetration through the head and sill flashings. Ensure separation is provided to prevent galvanic action. Frame finish shall be natural satin anodized finish, color-anodized finish or fluoropolymer Kynar 500 color coating. Finish of flashing, trim, and exposed fasteners shall match frame finish. Aluminum storefront may not have doors.

Aluminum entrance doors and/or frames shall be considered for use in schools with the Owner’s approval. If approved for use, the aluminum doors shall be hung on a full mortise continuous hinge, aluminum or stainless-steel finish.

1.01 SECTION INCLUDES

A. Aluminum-framed windows.

B. Aluminum-framed storefront, with vision glass.

C. Aluminum doors and frames.

D. Weatherstripping.

1.02 RELATED REQUIREMENTS

A. *Division 08 71 00* - Door Hardware: Hardware items other than specified in this section.
B. *Division 08 80 00* - Glazing: Glass and glazing accessories.
C. *Division 08 87 23* - Safety and Security Films.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
E. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
H. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
J. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2010).
K. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
    1. Include Design Engineer's stamp or seal on shop drawings for attachments and anchors.
D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
G. Designer's qualification statement.
H. Manufacturer's qualification statement.
I. Installer's qualification statement.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
    1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.

a. Insulating Glass Certification Council (IGCC).
b. Safety Glazing Certification Council (SGCC).

C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
a. North American Contractor Certification (NACC) for glazing contractors.
b. Equivalent independent third-party ANSI accredited certification.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.
B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals for additional warranty requirements.
B. Correct defective Work within a five-year period after Date of Substantial Completion.
C. Provide five-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
D. Provide five-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING (EXTERIOR)

A. Front-Set Style, Thermally-Broken:
1. Basis of Design: Kawneer; Trifab Versaglaze 601T and 451TT: www.kawneer.com/#sle.
2. Punched Windows set in concrete masonry openings: 451T Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
3. Storefronts set on concrete slab and adjacent to same (Area A) and Roof Monitor: 601Vertical Mullion Dimensions: 2 inches wide by 6 inches deep.

B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
1. Architectural Wall Systems, LLC (AWS): www.archwall.com
2. Arcadia, Inc: www.arcadiainc.com/#sle.
3. Avanti Systems, Inc.: www.avantisystemsusa.com/#sle
4. EFCO, LLC: www.efcocorp.com/#sle
5. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
6. Wausau Window and Wall Systems: www.wausauwindow.com/#sle.
7. Approved Equal.

C. Substitutions: See *Division 01 60 00* - Product Requirements.
1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.02 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING (INTERIOR)

A. Front-Set Style:
1. Basis of Design: Kawneer; Trifab Versaglaze 450. Framing System 1-3/4" Sightline.
2. Vertical Mullion Dimensions: 1-3/4 inches wide by 4-1/2 inches deep.

B. Interior All-Glass Storefront (Deductive Alternate “A”):
1. Avanti Solare Single Glazed Frameless Partition System
a. All-Glass Storefronts: Continuous heavy-duty stainless steel clad rail fitting at top and bottom
b. Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), tested for surface and edge compression per ASTM C 1048 and for impact strength per 16 CFR 1201 for Category II materials.
1) Class 1: Clear monolithic.
2) Thickness:3/4 inch.

2.03 BASIS OF DESIGN -- SWINGING DOORS

A. Wide Stile, Monolithic Glazing:
   1. Basis of Design: Kawneer 500 Standard.
   2. Thickness: 1-3/4 inches.
B. Wide Stile, Insulating Glazing, Thermally-Broken:
   1. Basis of Design: Kawneer 500T Insulpour Thermal Entrance.
   2. Thickness: 2-1/4 inches.

2.04 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Glazing Rabbet: For 1 inch insulating glazing.
   2. Glazing Rabbet: For 1/4-inch monolithic glazing.
   3. Finish: Superior performing organic coatings.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
   4. Finish Color: Champagne to match aluminum curtainwall.
   5. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12-hour period without causing detrimental effect to system components, anchorages, and other building elements.
   9. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
   10. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
   11. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.
B. Performance Requirements
   1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
      a. Design Wind Loads: Comply with requirements of ASCE 7.
      b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
   2. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.

2.05 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
   1. Glazing Stops: Flush.
      a. Coordinate glazing gaskets with impact resistant film sealant installation.
B. Glazing: See *Division 08 80 00*.
C. Swing Doors: Glazed aluminum.
   1. Thickness: As indicated above.
   2. Glazing Stops: Square.
   3. Finish: Same as storefront.

2.06 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).
B. Fasteners: Stainless steel.
C. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.07 ALUMINUM FINISHES

A. High-Performance Organic Coatings: AAMA 2604; multiple coats, thermally cured fluoropolymer system.
B. Color: Kawneer Permadize® (50% PVDF), AAMA 2604, Fluoropolymer Coating (Color: Champagne to match Metal Composite Material Wall Panels).
C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.08 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.
B. Other Door Hardware: See *Division 08 71 00*.
C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all exterior doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.
B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
E. Provide thermal isolation where components penetrate or disrupt building insulation.
F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form watertight dam.
G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
I. Set thresholds in bed of sealant and secure.
J. Install hardware using templates provided.
    1. See *Division 08 71 00* for hardware installation requirements.
K. Install glass using glazing method required to achieve performance criteria; see *Division 08 80 00*.
L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
B. See *Division 01 40 00* - Quality Requirements for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.
C. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
    1. Perform a minimum of two tests in each designated area as indicated on drawings.

2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

D. Provide field testing of installed storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as indicated on drawings.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
   3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.
      a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
   4. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf.
      a. Maximum allowable rate of air leakage is 0.09 cfm/sq ft.

E. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

DIVISION 08 44 13 – GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing and glass and metal spandrel panels, and shadow box.
   1. Including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of curtain wall framing.

B. Firestopping between curtain wall and edge of floor slab.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.

B. *Division 05 12 00* - Structural Steel Framing: Steel attachment members.

C. *Division 07 42 13.23* - Metal Composite Material Wall Panels.

D. *Division 07 84 00* - Firestopping: Firestop at system junction with structure.

E. *Division 08 41 13* - Aluminum-Framed Storefronts: Entrance framing and doors.

F. *Section 08 80 00* - Glazing.

G. *Section 08 87 23* – Safety and Security Films.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift; 2018.

D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

E. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

H. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

I. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
K. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
L. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2015a.
M. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
N. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
O. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 PERFORMANCE REQUIREMENTS

A. General Performance:
    1. Product to comply with the specified performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction, as determined by testing of glazed aluminum curtain walls representing those indicated for this project.
    2. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
    3. Failure includes any of these events:
        a. Thermal stresses transferring to building structure
        b. Glass breakage
        c. Loosening or weakening of fasteners, attachments, and other components.
B. Delegated Design:
    1. Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.06 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.
C. Product Data: Provide data on specified products, including adhesives, sealants, and paints, describing physical and performance characteristics.
D. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
E. Samples: Submit two samples 12 by 12 inches in size illustrating finished aluminum surface, glazing, infill panels, and glazing materials.
F. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
G. Design Data: Provide framing member structural and physical characteristics and engineering calculations and identify dimensional limitations; include load calculations at points of attachment to building structure.
H. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.
I. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
J. Designer's Qualification Statement.
K. Manufacturer's Qualification Statement.
L. Installer's Qualification Statement.

M. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

B. Verify that each component is appropriate for use in application regarding the following properties: size, shape, dimensions, material, shelf-life, storage conditions, and color/finish.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than five years of documented experience.

1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
   a. Insulating Glass Certification Council (IGCC).
   b. Safety Glazing Certification Council (SGCC).

D. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
   a. North American Contractor Certification (NACC) for glazing contractors.
   b. Equivalent independent third-party ANSI accredited certification.

1.08 MOCK-UPS

A. See *Division 01 40 00* - Quality Requirements for additional requirements.

B. Provide visual mock-up including each component being used on the project. Visual mock-up shall include sunshades and brackets, glazing materials, weep drainage system, attachments, anchors, perimeter sealant, accent elements and sunshades and brackets for attaching accent elements and sunshades. See drawings for dimensions of mock-up.

C. Locate on-site where directed by Architect; mock-up may remain as part of the Work.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive paper or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.10 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.11 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five-year period after Date of Substantial Completion.

C. Provide five-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide five-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN - CURTAIN WALL SYSTEMS

A. Basis of Design: Kawneer North America;

1. 1620 Curtain Wall System.
   a. Sightline: 2".
   b. System depth: 6".
   c. Outside-glazed pressure plate format.

B. Other Manufacturers: Provide either product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below.

1. Architectural Wall Systems, LLC (AWS): www.archwall.com
2. Arcadia, Inc: www.arcadiainc.com/#sle.
3. EFCO, LLC: www.efcocorp.com/#sle.
4. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
5. Wausau Window and Wall Systems: www.wausauwindow.com/#sle.
6. Approved Equal.

C. Substitutions: See *Division 01 60 00* - Product Requirements.
   1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.02 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Glazing Method: Unitized or field assembly and glazed.
   2. Provide flush joints and corners, weather sealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with the following:
      a. See wind load diagrams in structural drawings.
      b. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
      c. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
      d. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
   2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.
      Inter-storey Differential Lateral Movement: Meeting pass/fail criteria of AAMA 501.4 for Use Group I, Standard Occupancy, when tested at design displacement of 0.010 times greater adjacent story height, maximum, and 1.5 times design displacement, through three complete cycles.
   3. Movement: Accommodate the following movement without damage to components or deterioration of seals:
      a. Expansion and contraction caused by 180 degrees F surface temperature.
      b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12-hour period.
      c. Movement of curtain walls relative to perimeter framing.
      d. Deflection of structural support framing, under permanent and dynamic loads.

C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
   1. Static:
      a. The test specimen shall be tested in accordance with ASTM E 331.
      b. There shall be no leakage at a minimum static air pressure differential of 12 psf (575 Pa) as defined in AAMA 501.
   2. Cyclic:
      a. The test specimen shall be tested in accordance with ASTM E 547.
      b. There shall be no leakage at an air pressure differential of 12 psf (575 Pa) as defined in AAMA 501.
   3. Severe, Wind Driven Rain:
      a. The test specimen shall be tested in accordance with AAMA 520 and ASTM E 2268.
      b. There shall be no visible water at performance level 10, pressure limits 14 psf (670 Pa) to 42 psf (2010 Pa).

D. Air Leakage: 0.06 cfm/sq ft maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.27 psf pressure difference across assembly.
E. Thermal Performance Requirements:
    1. Thermal Resistance of Framing: 3.45 (deg F hr sq ft)/Btu, minimum per Zone 3 ASHRAE 90.1.
    2. When simulated using NFRC 100 or AAMA 507, the U-factor shall not be more than 0.41 Btu/(hr·ft^2·°F) based on 1" (25.4 mm) glass with a Center of Glass (COG) U-factor of 0.24 Btu/(hr·ft^2·°F) and an aluminum pressure plate.
F. Condensation Resistance Factor (CRF) or Temperature Index (TI):
    1. Captured: If using CRF, when tested using AAMA 1503, the CRFframe and CRFglass (with low-emissivity glazing) shall not be less than 75 and 71 respectively.
    2. Captured: If using TI, when tested to CSA A440-00, the TI_{frame} and TI_{glass} (with low-emissivity glazing) shall not be less than 70 and 63 respectively.
G. Acoustical Performance Requirements:
    1. Sound Transmission Loss:
        a. Captured: When tested to ASTM E90 and ASTM E1425, the Sound Transmission Class (STC) and Outdoor/Indoor Transmission Class (OITC) shall not be less than STC 34 or OITC 29 based upon 1" (25.4 mm) insulating glass (1/4", 1/2" AS, 1/4").

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
    1. Framing members for interior applications need not be thermally broken.
    2. Cross-Section: As indicated on drawings.
    3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
    4. Glazing System: Four-sided captured
    5. Glazing Plane: Front
B. Brackets and Reinforcements:
    1. Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.
C. Framing Sealants:
    1. Shall be suitable for glazed aluminum curtain wall as recommended by sealant manufacturer.
D. Fasteners and Accessories:
    1. Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories must be compatible with adjacent materials.
    2. Where exposed, fasteners and accessories shall be stainless steel.
E. Perimeter Anchors:
    1. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
F. Glazing: See Section 08 8000.
    1. Available Glazing Options:
        a. Outside glazed pressure plate format with 1" (25.4 mm) double glazed insulating glass
    2. Glazing Gaskets:
        a. Gaskets to meet requirements of ASTM C864.
    3. Spacers and Setting Blocks
        a. Manufacturer's standard elastomeric type.
    4. Bond-Breaker Tape:
        a. Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
    5. Glazing Sealants:
        a. As recommended by glazing and security film manufacturer for joint type.
G. Infill Panels: 0.125-inch-thick painted aluminum sheet. See Drawings for perforations and layout.
    1. Finish: High-performance organic coatings.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).
B. Sheet Aluminum: ASTM B209 (ASTM B209M).
C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
D. Structural Supporting Anchors: See *Division 05 12 00*.
E. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.
F. Structural Supporting Anchors Attached to Reinforced Concrete Members: Design for welded attachment to weld plates embedded in concrete.
G. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.
H. Exposed Flashings: Aluminum sheet, 20-gauge, 0.032-inch minimum thickness; finish to match framing members.
I. Firestopping: See *Division 07 84 00*.
J. Bituminous Paint:
   1. Cold-applied asphalt-mastic paint.
   2. Complies with SSPC-Paint 12 requirements except containing no asbestos.

DIVISION 08 45 00 – TRANSLUCENT WALL AND ROOF ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sandwich panel translucent wall system.

1.02 RELATED REQUIREMENTS

A. *Division 07 27 00* - Air Barriers: Sealing perimeter frame to water-resistive barrier installed on adjacent construction
B. *Division 07 92 00* - Joint Sealants: Sealing joints between perimeter frame and adjacent construction.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
B. AAMA CWM - Curtain Wall Manual; 2019.
C. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
G. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
H. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.
I. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2017.
J. ASTM D1003 - Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics; 2021.
K. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2023.
L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
M. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
N. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
O. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).

P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of firestopping and water-resistive barrier.
B. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, panel configuration, and internal drainage details.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, weep drainage network, expansion and contraction joint locations and details, and required field welding.
D. Samples: Two, 7 by 12 inches in size, illustrating prefinished aluminum surface, specified panel with skins, glazing materials illustrating edge and corner.
E. Design Data: Show structural and physical characteristics, engineering calculations, and dimensional limitations.
F. Test Reports: Substantiating engineering data, test results of previous tests by independent laboratory demonstrating compliance with performance requirements.
G. Installation Data: Special installation requirements.
H. Designer's qualification statement.
I. Manufacturer's qualification statement.
J. Installer's qualification statement.
K. Specimen warranty.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with AAMA CWM.
    1. Maintain one copy on project site.
B. Designer Qualifications: Design structural support framing components under direct supervision of Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
D. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.07 PERFORMANCE REQUIREMENTS

A. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.
    1. When requested, include span analysis data.
    2. Standard panel system shall have less than 0.01 cfm/ft² air leakage by ASTM E 283 at 6.24 PSF (50 mph) and no water penetration by ASTM E 331 at 15 PSF; and structural testing by ASTM E 330.
    3. Structural Loads. Provide system capable of handling the following loads:
        a. Positive Wind Load (PSF): as indicated on structural drawings.
        b. Negative Wind Load (PSF): as indicated on structural drawings.
B. Deflection Limits:
    1. Walls: Limited to L/120 of clear span for each assembly component.
C. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
    1. Temperature Change (Range): 110 deg F (43 deg C), ambient; 150 deg F (66 deg C), material surfaces.

1.08 MOCK-UPS

A. See *Division 01 40 00* - Quality Requirements for additional requirements.
B. Provide one mock-up, 2 ft long by 4 ft wide, include translucent panels, intermediate mullion, sill muntin, and insulated infill. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
C. Locate where directed.

D. Mock-up may remain as part of the Work.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Handle work of this section in accordance with AAMA CW-10.

B. Store panels on long edges above ground, blocked and under cover in accordance with manufacturer's storage and handling instructions.

C. Protect prefinished aluminum surfaces with wrapping; do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

1. Puncture wrappings at ends for ventilation.

1.10 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F.

B. Maintain this minimum temperature during and after installation of sealants.

1.11 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 10-year manufacturer warranty against deterioration of interior and exterior polycarbonate glazing panes. Complete forms in Owner's name and register with manufacturer. Include coverage for the following characteristics:

1. Change in Light Transmission: No greater than 6 percent when tested in accordance with ASTM D1003.
2. Color Stability of Glazing: Color change no greater 6 CIE Units DELTA E when evaluated according to ASTM D2244.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sandwich Panel - Translucent Wall and Roof Systems:

1. Basis of Design: Kalwall Corporation; www.kalwall.com/#sle.
2. Enduro Composites, Inc: www.endurocomposites.com/#sle
3. Major Industries, Inc: www.majorskylights.com/#sle.
4. Approved Equal.
5. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 DESIGN CRITERIA

A. System Design: Design and size assemblies and their components to withstand dead loads and live loads caused by snow, hail, and positive and negative wind loads acting on plane of panel without damage or permanent set.

1. Regulatory Requirements: Comply with applicable code criteria for loads, including seismic loads.
2. Design Loads: As indicated on drawings.

2.03 PERFORMANCE REQUIREMENTS

A. Measure structural performance in accordance with ASTM E330/E330M, using test load of 1.5 times the design wind pressure and 10 second duration of maximum load.

B. Deflection: Limit panel mullion deflection to L/120 with full recovery of glazing materials.

C. System Assembly: Accommodate without damage to system, components or deterioration of seals; movement within system; movement between system and perimeter framing components; dynamic loading and release of loads; deflection of structural support framing, tolerance of supporting components, shortening of building concrete structural columns, creep of concrete structural members, and inter-storey drift.

D. Color Stability: Color of exterior face sheet to not change color more than three CIE Units DELTA E in accordance with ASTM D2244 after 3 years outdoors in South Florida weathering facing south; color stability is not affected by abrasion or scratching.

E. Air Leakage: Limit air leakage through assembly to 0.01 cu ft/min sq ft of glazed area, measured at pressure differential across assembly of 6.24 psf in accordance with ASTM E283/E283M.

F. Static Pressure Vapor Seal: Provide vapor seal that maintains interior static pressure of at least 1 inch water column (WC) at 72 degrees F and 40 percent relative humidity.

G. Water Leakage: None, when measured in accordance with ASTM E331 at a test pressure difference of 15 psf.

H. Expansion/Contraction: System to provide for expansion and contraction within system components caused by a cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components.

I. System Internal Drainage: Drain water entering joints, condensation occurring in framing system, or migrating moisture occurring within system, to the exterior by a weep drainage network.

2.04 SYSTEMS

A. General: Shop-fabricated, factory-prefinished facade and roof systems consisting of various types of translucent assemblies, internal and external framing components, accessories, related flashings, anchorages, and attachments.

B. Sandwich Panel Translucent Wall and Roof Systems: Structurally reinforced translucent panel assemblies, with self-supporting panel framing, insulation, and internal grid of stiffener battens.

2.05 ASSEMBLIES

A. Sandwich Panel Assemblies: Bonded to both sides of structural extruded aluminum grid with manufacturer's standard pattern; exposed surfaces of exterior sheet chemically and permanently treated to protect against surface erosion and extreme weather conditions; polyvinyl fluoride film coated.
   1. Panel Length and Width: As indicated on drawings.
   2. Panel Thickness: 4 inches.
   3. Sandwich Panel Insulation: Manufacturer's standard translucent type, with substantive thermal and acoustical properties.
      a. Type: Glass fiber.
      b. Thermal Performance: U-Value of 0.15.
   4. Sandwich Panel Face Sheets: Fiberglass reinforced polymer (FRP).
      a. Type: Flat panel.
      b. Exterior Face Sheet: Translucent, and smooth.
         1) Color: White.
         2) Thickness: 0.070-inch, minimum.
      c. Interior Face Sheet: Translucent, and smooth.
         1) Color: White.
         2) Thickness: 0.045-inch, minimum.
         3) Provide exposed surface of interior face sheets with Flame Spread Index (FSI) of less than 25 and Smoke Developed Index (SDI) of less than 450 in accordance with ASTM E84 and UL 723.
         4) Provide face sheets with burn extent no greater than 1 inch complying with ASTM D635.
   5. Performance:
      a. Center of Glazing U-Value: 0.15 Btu/hr sq ft degrees F maximum.
      b. Overall Light Transmittance (LT): 11 percent, nominal.
      c. Overall Shading Coefficient: 0.06, nominal.
      d. Overall Solar Heat Gain Coefficient (SHGC): 0.23, minimum.

B. Grid Core:
   1. Thermally Broken Composite I-beam grid core shall be of alloy and temper recommended by manufacturers with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I-beam shall be no less than 7/16”.
   2. I-beam Thermal break: Minimum 2”, thermoset fiberglass composite. Poured and de-bridged thermal break is not acceptable.

C. Battens, Cover Strips, Cover Plates, and Integral Flashings: Extruded aluminum, to suit location and application; sized to rigidly retain panels in place.

D. Flashings: 0.040-inch-thick aluminum, Color and finish to match Metal Composite Material, secured with concealed fastening method.

E. Weather Seals: To suit application, non-bleeding; non-staining.

F. Sealant Within Translucent Assembly: As required by manufacturer; see Section 07 9200.

G. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, and compatible with flashing material; see Section 07 9200.

2.06 ALUMINUM CLAMPTITE INSTALLATION SYSTEM

A. Aluminum clamptite installation system:
   1. Thermally Broken-Flat clamp-tite screw type closure system shall be of extruded aluminum alloy and temper as recommended by manufacturer.

B. Sealing tape: Manufacturer's standard, pre-applied to aluminum clamptite installation system at the factory under controlled conditions.
C. Fasteners: 300 series stainless steel screws for aluminum clamptite installation system, excluding final fasteners to the building.
D. Finish:
1. Manufacturer's factory applied finish, which meets the performance requirements of AAMA 2604. Color to match Metal Composite Material.

2.07 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).
B. Fiberglass Reinforced Polymer Sheets: Ultraviolet (UV) protected.
1. Tensile Strength: 23,000 psi, minimum, when tested in accordance with ASTM D638.
2. Flexural Modulus: 1,100,000 psi, minimum, when tested in accordance with ASTM D790.
3. Light Transmittance, Clear, Transparent Sheet: 92 percent, minimum, determined in accordance with ASTM D1003.
C. Exposed Flashings: Aluminum sheet, 20-gauge, 0.032-inch minimum thickness; finish to match framing members.
D. Concealed Flashings: Sheet aluminum, 26-gauge, 0.017-inch minimum thickness.
E. Fasteners: Stainless steel.

2.08 FABRICATION

A. Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, and ensure proper installation and dynamic movement of perimeter seals.
B. Accurately fit and secure joints and corners. Make joints flush and hairline.
C. Prepare components to receive fabricated anchor devices.
D. Locate fasteners and attachments to ensure concealment from view.
E. Reinforce framing members for external imposed loads.

2.09 FINISHES

A. Aluminum Materials:
1. Superior Performing Organic Coatings: AAMA 2605; multiple coats, thermally cured polyvinylidene fluoride system.
2. Color: To match Metal Composite Material.
3. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.
B. Verify wall openings and adjoining water-resistive barrier materials are ready to receive translucent wall and roof assemblies; see Section 07 2700.

3.02 SURFACE PREPARATION

A. Where aluminum contacts dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
B. Where aluminum contacts concrete, masonry or pressure treated wood, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturers.

3.03 INSTALLATION

A. Install translucent panel system with cells vertical in accordance with manufacturer instructions.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances and align with adjacent work.
E. Provide thermal isolation where components penetrate or disrupt building insulation.
F. Install sill flashings.
G. Coordinate installation of air stops at edge of construction.
H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

3.04 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 1/2 inch per 100 feet, whichever is less.
B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
C. Sealant Space Between Panel System Members and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.05 FIELD QUALITY CONTROL

A. Provide the services of the manufacturer's field representative to observe installation and make report.
B. Provide independent inspection under provisions of *Division 01 40 00* - Quality Requirements.
C. Inspection will monitor quality of installation and glazing.
D. Test installed wall and roof assemblies for water leakage in accordance with AAMA 501.2.

3.06 CLEANING

A. Remove protective material from prefinished aluminum surfaces.
B. Wash down interior and exterior surfaces with solution of mild detergent in warm water, applied with soft, clean wiping cloths; remove dirt from corners and wipe surfaces clean.

3.07 PROTECTION

A. Protect finished work from damage until Date of Substantial Completion.

DIVISION 08 51 00 – METAL WINDOWS AND STOREFRONTS

Storefront and Window Replacement

Prior to the design phase of a window replacement project, a window opening shall be identified and demolished to reveal site conditions to be addressed by the project that would otherwise remain unseen. This opening may serve as the site of the mockup before project commencement.
If project budget allows, MSCS recommends, as best practice to include, as a part of any window replacement project, the cleaning, tuck pointing and sealing of the building envelope.
All exterior windows are to be recessed or otherwise protected from direct exposure to precipitation.
Construction shall be thermally broken aluminum storefront. Storefronts shall be fixed units unless required otherwise by code. Hollow metal frames shall be used at sidelights and transoms adjacent to entrance doors. Where operable units are required by code, the designer is to determine the best window type to meet the criteria.

Do not use steel or wood windows on the exterior.

A horizontal frame approximately 36" above finish floor shall be provided at full height windows, full height curtain walls and sidelights to protect against walking into glass.
Vandal resistant systems shall be used whenever possible. Secure locks and latches that cannot be “jimmied” or broken are important in all cases. MSCS recommends the installation of laminated glass/ glazing on all first-floor windows and doors. If budget allows, MSCS would like all exterior glass/ glazing to be laminated.
Windows in occupied spaces such as classrooms, project rooms, offices, conference rooms, etc. shall have window treatments such as sunshades or blinds. An alternate pricing is requested for these items.

GLAZING: Refer to *DIVISION 08 80 00 - GLAZING*.
STOOLS: A non-absorbent, easily cleanable surface shall be provided at windowsills. Solid surface stools are acceptable. Mechanically anchored slates and polymer stools, ceramic and quarry tiles are acceptable. Wood, gyp board, plastic laminate, metal, and concrete masonry unit stools shall not be used.

WINDOWS & STOREFRONT: Glaze windows from interior. Do not use hollow metal storefront without protection from the elements.

DIVISION 08 71 00 – DOOR HARDWARE

PART 1 – GENERAL

All door hardware specifications are to be reviewed by MSCS Locksmith and MSCS Department of Major Construction PM. All hardware is to be compliant with current adopted codes and ADA criteria. This hardware specification is to be submitted to the Project Manager for review prior to incorporation into the Project Manual.

Use full length piano hinges on exterior and high use doors. Use of automatic openers are discouraged but may be used only at the Main Entry with approval by MSCS. Due to pandemic criteria, the designer shall make recommendations for use of hands-free hardware.

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:
   1. Swinging doors.
   2. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:
   1. Mechanical door hardware.
   2. Electromechanical door hardware.
   3. Automatic operators.
   4. Cylinders specified for doors in other sections.

C. Related Sections:
   1. Division 08 Section “Hollow Metal Doors and Frames”.
   2. Division 08 Section “Flush Wood Doors”.
   3. Division 08 Section “Sound Control Hollow Metal Door Assemblies”.
   4. Division 08 Section “Sound Control Wood Door Assemblies”.
   5. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
   6. Division 08 Section “Automatic Door Operators”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
   1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
   2. ICC 500-2014/2020, ICC/NSSA Standard for the Design and Construction of Storm Shelters.
   3. ICC/IBC - International Building Code.
   4. NFPA 70 - National Electrical Code.
   5. NFPA 80 - Fire Doors and Windows.
   6. NFPA 101 - Life Safety Code.
   7. NFPA 105 - Installation of Smoke Door Assemblies.
   8. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
   9. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
   1. ANSI/BHMA Certified Product Standards - A156 Series.
   2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
   3. ANSI/UL 294 - Access Control System Units.
   4. UL 305 - Panic Hardware.
   5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size,

thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:
    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:
    1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
        a. Elevation diagram of each unique access-controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
        b. Complete (risers, point-to-point) access control system block wiring diagrams.
        c. Wiring instructions for each electronic component scheduled herein.
    2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
D. Proof of Qualification: Provide copy of manufacturer(s) Factory Trained Installer documentation indicating proof of status as a qualified installer of tornado or hurricane storm shelter assemblies.
E. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
F. Informational Submittals:
    1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
    1. Maintenance manuals must be provided for tornado/hurricane storm shelter impact protective systems.
B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum of 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum of 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum of 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier is recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Storm Shelter Impact Protective Assembly Installer Qualifications: Installers are to be factory trained for shop and field installation prior to project bid, and are responsible for commissioning, servicing, and warranting the installed equipment specified for the project. A pre-installation site inspection of the frame and floor conditions shall be conducted by the factory trained installer prior to any Storm Shelter Impact Protective assembly hardware applied to the opening.

F. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
   1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third-party source will not be accepted.
   2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

G. Storm Shelter Openings: Provide complete door systems for hurricane or tornado resistant storm shelters and other areas of refuge complying and tested according to ICC 500 (2014/2020), ICC/NSSA Standard for the Design and Construction of Storm Shelters.

H. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

I. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
   1. Function of building, purpose of each area and degree of security required.
   2. Plans for existing and future key system expansion.
   3. Requirements for key control storage and software.
   4. Installation of permanent keys, cylinder cores and software.
   5. Address and requirements for delivery of keys.

J. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
   1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
   2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
   3. Review sequence of operation narratives for each unique access-controlled opening.
   4. Review and finalize construction schedule and verify availability of materials.

5. Review the required inspecting, testing, commissioning, and demonstration procedures

K. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Storm Shelter Openings: Furnish a complete set of operational and maintenance instructions as needed for Owner's continued adjustment, maintenance, and repairs of door hardware as required by ICC 500 (2020), ICC/NSSA Standard for the Design and Construction of Storm Shelters.

PART 2 - PRODUCTS

2.1 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:
   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
    b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
    a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
    a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
5. Manufacturers:
    a. McKinney (MK) - TA/T4A Series, 5-knuckle.

B. Hinges at Storm Shelter Assemblies: At a minimum, provide heavy weight hinges with stainless steel screws used in accordance with and specified as part of a Severe Storm Shelter Opening meeting ICC 500 and FEMA 361.
1. Quantity: Provide the following hinge quantity:
    a. Three Hinges: For shutters with heights 36 to 60 inches, and doors at height of 80 inches.
    b. Four Hinges: For shutters with heights > 60 inches to 80 inches, and doors with heights greater than 84 inches.
2. Quantity: Provide the following hinge quantity:
    a. Three Hinges: For shutters with heights 36 to 60 inches, and doors at height of 80 inches.
    b. Four Hinges: For shutters with heights > 60 inches to 80 inches, and doors with heights greater than 84 inches.
    c. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    d. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
    e. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
    b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
4. Hinge Weight and Base Material: At a minimum, provide heavy weight hinges with stainless steel screws used in accordance with and specified as part of a certified Storm Shelter Opening meeting ICC 500.
5. Manufacturers:
    a. McKinney (MK) - SP3386/SP3786.
    b. No Substitution.

2.2 CONTINUOUS HINGES

A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
1. Manufacturers:.
    a. Pemko (PE).

B. Pin and Barrel Continuous Hinges: ANSI/BHMA A156.26 Grade 1-600 pin and barrel continuous hinges with minimum 14 gauge Type 304 stainless steel hinge leaves, concealed stainless pin, and twin self-lubricated nylon bearings at each knuckle separation. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

a. Markar Products; ASSA ABLOY Architectural Door Accessories (MR).
b. Pemko (PE).

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
   1. Manufacturers:
      a. McKinney (MK) - QC (# wires) Option.

B. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
   1. Manufacturers:
      a. Pemko (PE) - EL-CEPT Series.
      b. Securitron (SU) - EL-CEPT Series.

C. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
   1. Provide one each of the following tools as part of the base bid contract:
      a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
      b. McKinney (MK) - Connector Hand Tool: QC-R003.
   2. Manufacturers:
      a. McKinney (MK) - QC-C Series.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.
   1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
   2. Furnish dust proof strikes for bottom bolts.
   3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
   4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
   5. Manufacturers:
      a. Rockwood (RO).
      b. Trimco (TC).

B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.
   1. Manufacturers:
      a. Rockwood (RO).
      b. Trimco (TC).

C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
   1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
   2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware

sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.

3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
6. Manufacturers:
    a. Rockwood (RO).
    b. Trimco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years’ experience designing secured master key systems and have on record a published security keying system policy.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Match Facility Standard.

C. Large Format Interchangeable Cores: Provide removable cores (LFIC) as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.

D. Security Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed security cylinders and keys able to be used together under the same facility master or grandmaster key system. Cylinders to be factory keyed.

1. New security key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
2. Manufacturers:
    a. Sargent (SA) - Degree DG2
    b. No Substitution per owners’ request

E. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer’s United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.

1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
2. Manufacturers:
    a. Sargent (SA) - Degree DG1.
    b. No Substitution per owners’ request

Keying System: Each type of lock and cylinders to be factory keyed.

3. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
4. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
5. Existing System: Field verify and key cylinders to match Owner's existing system.

F. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).
4. Construction Control Keys (where required): Two (2).

5. Permanent Control Keys (where required): Two (2).

G. Construction Keying: Provide temporary keyed construction cores.

H. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:
   a. Lund Equipment (LU).
   b. MMF Industries (MM).
   c. Telkee (TK).

2.7 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:
   a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - 8800FL Series.
   b. Corbin Russwin Hardware (RU) - ML2000 Series.
   c. Sargent Manufacturing (SA) - 8200 Series.

2.8 MULTI-POINT LOCKS AND LATCHING DEVICES

A. Multi-Point Locksets, Storm Shelter: Provide ANSI/BHMA A156.37, Series 1000, Operational Grade 1 and Security Grade 1 Certified Products Directory (CPD) listed multi-point locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide locksets with functions and features as follows:
   a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
   b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
   c. Meets Florida Building Code FL2998 and UL Certification Directory ZHEM.R21744 for latching hardware for hurricane requirements.
   d. Approved for usage as part of a complete ICC 500 (2014/2020) and FEMA P-361 (2015/2021) door, frame, and hardware assemblies for storm shelter components.
   e. Lever torque to retract all bolts less than 28 in.lb.
   f. Cycle tested to 1,000,000 cycles.
   g. Seven-year limited warranty for mechanical functions.
2. Electromechanical locksets shall have the following functions and features:
   a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable to fail safe or fail secure and operate from 12vdc to 24vdc regulated.
   b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
   c. Optional deadbolt and latchbolt monitoring.
3. Manufacturers:
   a. Corbin Russwin Hardware (RU) - FE6600 Series.
   b. Sargent Manufacturing (SA) - FM7300 Series.

2.9 DEADLOCKS AND LATCHES

A. Mortise Deadlocks, Large Case: ANSI/BHMA A156.13 Grade 1 Certified Products Directory (CPD) listed large case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. One piece stainless steel bolts with a 1" throw. Deadlocks to be products of the same source manufacturer and keyway as other locksets.

1. Manufacturers:

a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - 8800 Series.
b. Corbin Russwin Hardware (RU) - ML2000 Series.
c. Sargent Manufacturing (SA) - 8200 Series.

Narrow Case Deadlocks and Deadlatches: ANSI/BHMA 156.13 Series 10 00 Grade 1 narrow case deadlocks and deadlatches for swinging or sliding door applications. All functions shall be manufactured in a single sized case formed from 12 gauge minimum, corrosion resistant steel (option for fully stainless steel case and components). Provide minimum 2 7/8" throw laminated stainless steel bolt. Bottom rail deadlocks to have 3/8" diameter bolts.

2. Manufacturers:
   a. Adams Rite Manufacturing (AD) - MS1850S / MS1950 Series.
   b. Adams Rite Manufacturing (AD) - 4900 Series.

2.10 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
   3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
   4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:
   1. Strikes for Mortise Locks and Latches: BHMA A156.13.
   2. Strikes for Bored Locks and Latches: BHMA A156.2.
   3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
   4. Dustproof Strikes: BHMA A156.16.

2.11 ELECTRIC STRIKES

A. Surface Mounted Rim Electric Strikes: Surface mounted rim exit device electric strikes conforming to ANSI/BHMA A156.31, Grade 1, and UL Listed for both Burglary Resistance and for use on fire rated door assemblies. Construction includes internally mounted solenoid with two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Strikes tested for a minimum of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike. Strike requires no cutting to the jamb prior to installation.
   1. Manufacturers:
      a. HES (HS) - 9400/9500/9600/9700/9800 Series.

B. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five-year warranty.

2.12 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
   1. Exit devices shall have a five-year warranty.
   2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
   3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
   4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.
10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
1. Electromechanical exit devices shall have the following functions and features:
    a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
    b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
    c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
    d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
    e. Five-year limited warranty for electromechanical features.
2. Manufacturers:
    a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - 7000 Series.
    b. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
    c. Sargent Manufacturing (SA) - 80 Series.

C. Multi-Point Exit Devices (Storm Shelter Openings): Multi-point exit devices specifically engineered for out-swinging door applications on tornado or hurricane resistant storm shelter openings. Extra heavy duty steel component construction with each of the latching points automatically activated when the device is locked. The multi-point exit device is approved for usage as part of a complete ICC 500 (2014/2020) and FEMA P-361 (2015/2021) door, frame and hardware assembly.
1. Manufacturers:
    a. Corbin Russwin Hardware (RU) - FE5400S Series.
    b. Sargent Manufacturing (SA) - FM8700 Series.

2.13 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with

Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
7. Storm Shelter Compliance: Door closers to be U.L. listed for windstorm assemblies where applicable. Provide the appropriate storm shelter products that have been independently third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one-piece cast-iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Large body cast iron surface mounted door closers shall have a 30-year warranty.
2. Manufacturers:
   a. Corbin Russwin Hardware (RU) - DC8000 Series.
   b. Sargent Manufacturing (SA) - 281 Series.

C. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Heavy duty surface mounted door closers shall have a 30-year warranty.
2. Manufacturers:
   a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - 4400 Series.
   b. Corbin Russwin Hardware (RU) - DC6000 Series.
   c. Sargent Manufacturing (SA) - 351 Series.

D. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.

1. Manufacturers:
   a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - 3500 Series.
   b. Corbin Russwin Hardware (RU) - DC6000 Series.
   c. Sargent Manufacturing (SA) - 1431 Series.

2.14 ELECTROHYDRAULIC DOOR OPERATORS

A. Electrohydraulic Door Operators (High Traffic): Provide ANSI/BHMA A156.19 Certified Products Directory (CPD) listed low energy operators that meet ANSI/BHMA A156.4 requirements and are UL listed for use on fire rated doors and UL10C certified that comply with requirements for the Americans with Disabilities Act (ADA). Operators shall be verified by GreenCircle to offer energy savings of 19% when compared to similar products to accommodate openings up 250 pounds and 48” wide.

1. Provide operators with features as follows:
   a. Non-handed with push and pull side mounting.
   b. Operates as mechanical surface closer during close cycles, when door is opened manually or if power is off.
   c. Activation by push button, hands-free or radio frequency devices.
   d. On board electronics to collect usage and cycle count data to facilitate

preventative maintenance/diagnostics.

e. Two-year limited warranty.

f. Wi-Fi interface where the operator is a secure, password protected WiFi hot spot with no connection to building's IT required.

1) Simple setup with no app required.

2) View status and make adjustments without removing the cover.

3) Built-in logic to support single use restroom applications with no external relay boards, logic modules, position switches required.

g. Mounting backplate to simplify and speed up installation.

2. Operators shall have the following functionality:

a. Adjustable Hold Open: Amount of time a door will stay in the full open position after an activation.

b. Blow Open for Smoke Ventilation: Door opens when signal is received from alarm system allowing air or smoke to flow through opening. Door will stay open until signal from alarm system is stopped.

c. Infinite Hold Open: Door will hold open at set position until power is turned off.

d. Obstruction Detection: Door closes if it hits an obstruction while opening; door will reverse to open position if it hits an obstruction while closing. Door will stop once it hits an obstruction and will rest against the obstruction until removed.

e. Open Delay: Delays operator opening for locking hardware.

f. Overload Safety Shut-Off: After two minutes of receiving a door activation signal, inverter times out and door closes to prevent motor/inverter damage.

g. Presence Detector Input: Input for external sensor to detect presence at door open or close position only.

h. Push & Go: As the door is manually opened, the operator "senses" movement and opens door to the full-open position.

i. Selector Mode Switch: Off disables the signal inputs unless Blow Open is activated, on activates the signal inputs, hold open activates the unit (unless Blow Closed is activated) to the hold open position.

j. Vestibule Delay: When the wall switch is pressed, first door in vestibule will open. Second door will open once vestibule door delay has expired. Delay is adjustable.

3. Manufacturers:

a. Norton Rixson (NO) - 6000 Series.

2.15 SURFACE MOUNTED CLOSER HOLDERS

A. Electromagnetic Door Holders: ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate.12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.

1. Manufacturers:

a. Norton Rixson (RF) - 980/990 Series.

b. Sargent Manufacturing (SA) - 1560 Series.

2.16 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
    a. Rockwood (RO).
    b. Trimco (TC).

2.17 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
    1. Manufacturers:
        a. Rockwood (RO).
        b. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
    1. Manufacturers:
        a. Norton Rixson (RF).
        b. Rockwood (RO).
        c. Sargent Manufacturing (SA).

2.18 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
    1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
    1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Hurricane and Storm Shelter Compliance: Devices to be U.L. listed for windstorm assemblies where applicable. Provide the appropriate hurricane or storm shelter products that have been independently third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.

G. Manufacturers:
    1. National Guard Products (NG).
    2. Pemko (PE).

2.19 ELECTRONIC ACCESSORIES

A. Push-Button Switches: Industrial grade momentary or alternate contact, back-lighted push buttons with stainless-steel switch enclosures. 12/24 VDC bi-color illumination suitable for either flush or surface mounting.

1. Manufacturers:
    a. Alarm Controls (AK) - TS Series.
    b. Securitron (SU) - PB Series.

2.20 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.21 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
B. Notify Architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
    1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including hanging devices; locking devices; closing devices; and seals.
B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
    1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
    2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
    3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
    4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
F. Storage: Provide a secure lock-up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
   1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

B. Maintenance manuals must be provided for tornado/hurricane storm shelter impact protective systems.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction sites in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
   1. Quantities listed are for each pair of doors, or for each single door.
   2. The supplier is responsible for handling and sizing all products.
   3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
   4. At existing openings with new hardware, the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Refer to *Division 08 71 00*, Door Hardware Sets, for hardware sets.

Manufacturers Abbreviations:

OT – Other	SU - Securitron
MK – McKinney	SA - SARGENT
PE – Pemko	RF - Rixson
MR – Markar	NO - Norton
RO – Rockwood	HS - HES

DIVISION 08 80 00 – GLAZING

PART 1 GENERAL

Insulated glass shall be installed at exterior windows in accordance with local energy codes and per the energy model requirements of the engineering consultant. Tempered glass shall be installed at and adjacent to doors as required by the code. Interior glazing 6'-0" or less above the finish floor and exterior glazing 6'-0" or less above walkway surfaces shall be tempered. MSCS prefers that all glazing at ground level or 1st story be laminated with ballistic film as required by State Safety Standards. If budget allows, all glass and glazing should be laminated.

1.01 SECTION INCLUDES

A. Glazing units.
B. Glazing compounds.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.
B. *Division 08 1113* - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
C. *Division 08 43 13* - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.
D. *Division 08 44 13* - Glazed Aluminum Curtain Walls: Glazing provided as part of wall assembly. Confirm and coordinate any special requirements of glass assembly with curtain wall manufacturer.
E. *Division 08 87 23* - Safety and Security Films.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.
C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
F. ASTM C1036 - Standard Specification for Flat Glass; 2016.
G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
I. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.
J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
K. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
L. GANA (GM) - GANA Glazing Manual; 2008.
M. GANA (SM) - GANA Sealant Manual; 2008.
N. GANA (LGRM) - Laminated Glazing Reference Manual; 2019.
O. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).
P. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2017.
Q. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014, with Errata (2017).
R. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
D. Samples: Submit two samples 12 by 6 inch minimum in size of glass units.
E. Manufacturer's qualification statement.
F. Installer's qualification statement.
G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
    1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
        a. Insulating Glass Certification Council (IGCC).
        b. Safety Glazing Certification Council (SGCC).
C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years' documented experience.
    1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
        a. North American Contractor Certification (NACC) for glazing contractors.
        b. Equivalent independent third-party ANSI accredited certification.
D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.07 MOCK-UPS

A. See *Division 01 40 00* - Quality Requirements for additional requirements.
B. See *Division 01 43 39* - Mockups for additional requirements.
C. Provide on-site glazing mock-up with the specified glazing components.
D. Locate as indicated by Architect.

1.08 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.
B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.09 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals for additional warranty requirements.
B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.
C. Heat-Soaked Tempered Glass: Provide a five (5) year manufacturer warranty to include coverage for spontaneous breakage of fully tempered glass caused by nickel sulfide (NiS) inclusions.

1.10 DELIVERY, STORAGE AND HANDLING

A. All glass and related materials shall arrive at the job site properly packed and crated and marked to agree with the approved shop drawings and bearing factory labels on each pane. Labels shall not be removed until final inspection.
B. Store material under cover on wood runners on floors in an upright position and in a manner that will prevent damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Float Glass Manufacturers:
    1. Basis of Design: Vitro Architectural Glass (formally PPG Glass): www.vitroglazings.com/#sle.
    2. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
    3. Guardian Glass, LLC: www.guardianglass.com/#sle.
    4. Pilkington North America Inc: www.pilkington.com/na/#sle.
    5. Approved Equal.

6. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7
   4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   5. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
   1. In conjunction with weather barrier related materials described in other sections, as follows:
      a. Air Barriers: See *Division 07 27 00*.
   2. To utilize inner pane of multiple pane insulating glass units for continuity of vapor retarder and/or air barrier seal.
   3. To maintain a continuous vapor retarder and/or air barrier throughout glazed assembly from glass pane to heel bead of glazing sealant.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS (TYPICAL INTERIOR)

A. Float Glass: Provide float glass-based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   5. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on high-risk or other demanding applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with industry established testing requirements.

2.04 INSULATING GLASS UNITS (TYPICAL EXTERIOR)

A. Manufacturers:
   1. Glass: Any of the manufacturers specified for float glass.
   2. Basis of Design: Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
   3. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
   4. Guardian Glass, LLC: www.guardianglass.com/#sle.
   5. Pilkington North America Inc: www.pilkington.com/na/#sle.Pilkington North America Inc: www.pilkington.com/na/#sle.
   6. Viracon, Apogee Enterprises, Inc: www.viracon.com/#sle.
   7. Approved Equal.
   8. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

C. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.

2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; or coated spandrel glass, Kind CS.
3. Metal-Edge Spacers: Aluminum, bent and soldered corners.
4. Spacer Color: Black.
5. Edge Seal:
    a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
    b. Color: Black.
6. Purge interpane space with argon gas, hermetically sealed.

D. Type GL-1 - Insulating Glass Units: Vision glass (GL-V), double glazed, ultra-clear.
1. Applications: Exterior glazing unless otherwise indicated.
2. Vitro Glass Solarban 90 (2) Actuity + Actuity.
3. Space between lites filled with argon gas, 1/2" nominal.
4. Outboard Lite: Heat-strengthened float glass, 1/4 inch thick, minimum.
    a. Tint: Clear.
    b. Coating: Low-E (passive type), sputtered on #2 surface.
5. Metal edge spacer. Color Black.
6. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
    a. Tint: Clear.
    b. Coating: None.
7. Total Thickness: 1 inch.
8. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.29 or less, nominal.
9. Visible Light Transmittance (VLT): 53 percent, nominal.
10. Solar Heat Gain Coefficient (SHGC): 0.23 or less, nominal.
11. Visible Light Reflectance, Outside: 12 percent, nominal.
12. Glazing Method: Dry glazing method, gasket glazing.
13. Safety Glazing: Same type excpt use fully tempered float glass for both outboard and inboard lites. Applications:
    a. Glazed lites in exterior doors
    b. Glazed sidelights and panels next to doors
    c. Other locations required by applicable federal, state, and local codes and regulations
    d. Other locations indicated on drawings

E. Type GL-1A: Type GL-1 Insulating Glass Units with Impact Resistant Film (Safety and Security Film). Vision Glass (GL-V), double glazed, ultra-clear.
1. Applications: Exterior glazing where indicated.
2. See Type GL-1 for properties.
3. Adhere Safety and Security Film on no. 4 surface.

F. Type GL-2 Insulating Glass Units: Vision Glass (GL-V), double glazed, ultra-clear.
1. Applications:
    a. Exterior glazing unless otherwise indicated.
    b. Vitro Glass Solarban 70 (2) Optigray + Clear.
    c. Space between lites filled with argon gas, 1/2" nominal.
    d. Outboard Lite: Heat-strengthened float glass, 1/4 inch thick, minimum.
        1) Tint: Optigray.
        2) Coating: Low-E (passive type), sputtered on #2 surface.
    e. Metal edge spacer. Color Black.
    f. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
        1) Tint: Clear.
        2) Coating: None.
    g. Total Thickness: 1 inch.
    h. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.28 or less, nominal.
    i. Visible Light Transmittance (VLT): 46 percent, nominal.
    j. Solar Heat Gain Coefficient (SHGC): 0.23 or less, nominal.
    k. Visible Light Reflectance, Outside: 9 percent, nominal.

l. Glazing Method: Dry glazing method, gasket glazing.
m. Safety Glazing: Same type except use fully tempered float glass for both outboard and inboard lites.Applications:
1) Glazed lites in exterior doors.
2) Glazed sidelights and panels next to doors.
3) Other locations required by applicable federal, state, and local codes and regulations.

2. Type GL-2A Insulating Glass Units: Spandrel glazing. Double glazed
a. Applications: Exterior spandrel glazing where indicated on drawings.
b. Vitro Glass Solarban 60 (2) SolarGray + Clear + Opaci-Coat 300 Spandrel Coating.
c. Space between lites filled with argon gas, 1/2" nominal.
d. Outboard Lite: Heat-strengthened float glass, 1/4 inch thick, minimum.
1) Tint: SolarGray.
2) Coating: Low-E (passive type), sputtered on #2 surface.
e. Metal edge spacer. Color Black.
f. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
1) Tint: Clear.
2) Coating: Opaci-Coat 300; #3-5283 Meteor Shower on #4 Surface.
g. Total Thickness: 1 inch.
h. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.29 or less, nominal.
i. Visible Light Transmittance (VLT) without spandrel coating: 35 percent, nominal.
j. Solar Heat Gain Coefficient (SHGC) without spandrel coating: 0.25 or less, nominal.
k. Visible Light Reflectance, Outside, without spandrel coating: 6 percent, nominal.
l. Glazing Method: Dry glazing method, gasket glazing.

2.05 MONOLITHIC GLAZING UNITS

A. Type GL-4 - Monolithic Interior Vision Glazing (GL-V)
1. Applications: Interior glazing unless otherwise indicated.
2. Glass Type: Fully tempered float glass.
3. Tint: Ultra-Clear.
4. Thickness: 1/4-inch, nominal.
5. Visible Light Transmittance (VLT): 91 percent, nominal.
6. Shading Coefficient: 1.03, nominal.
7. Solar Heat Gain Coefficient (SHGC): 90, nominal.
8. Visible Light Reflectance, Outside: 8 percent, nominal.
9. Glazing Methods: Dry glazing method, gasket glazing; Wet/dry glazing method, preformed tape and sealant; Butt joint glazing method, sealant only.
10. Safety Glazing: Same type except use fully tempered float glass. Applications:
a. Glazed lites in non-fire rated doors.
b. Glazed sidelights and panels next to doors.
c. Other locations required by applicable federal, state, and local codes and regulations.
11. Fire Rated Glazing: 5/16” Fire and Safety Glazing. Applications:
a. Vision lites in fire rated doors. Glass fire rating to match door and frame rating.
b. Other locations required by applicable federal, state, and local codes and regulations.

2.06 GLAZING COMPOUNDS

A. Type GC-2 - Butyl Sealant: Single component; ASTM C920 Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.
B. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; Black color.
C. Manufacturers:
1. Basis of Design: Bostik Inc: www.bostik-us.com/#sle.
2. Dow Corning Corporation: www.dowcorning.com/construction/#sle.
3. Master Builders Solutions: www.master-builders-solutions.com/en-us/#sle.
4. Momentive Performance Materials, Inc: www.momentive.com/#sle.
5. Pecora Corporation: www.pecora.com/#sle.
6. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

7. Approved Equal.
8. Substitutions: See *Division 01 60 00* - Product Requirements.

2.07 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3-inch long by one half the height of the glazing stop by thickness to suit application, self-adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

2.08 SOURCE QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements for additional requirements.

B. Provide shop inspection and testing for Insulated Glass Units.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturers.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 INSTALLATION - WET GLAZING METHOD (SEALANT AND SEALANT)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Place setting blocks at 1/4 points and install glazing pane or unit.

C. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24-inch intervals, 1/4 inch below sight line.
D. Fill gaps between glazing and stops with silicone type sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.
E. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.06 INSTALLATION - WET/DRY GLAZING METHOD (PREFORMED TAPE AND SEALANT)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
B. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with butyl sealant.
C. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
D. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
E. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
F. Install removable stops, with spacer strips inserted between glazing and applied stops 1/4 inch below sight lines.
    1. Place glazing tape on glazing pane of unit with tape flush with sight line.
G. Fill gap between glazing and stop with butyl type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.
H. Apply cap bead of butyl type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.07 INSTALLATION - PLASTIC FILM

A. Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.
B. Place without air bubbles, creases or visible distortion.
C. Install film tight to perimeter of glass and carefully trim film with razor sharp knife. Provide 1/16 inch to 1/8-inch gap at perimeter of glazed panel unless otherwise required. Do not score the glass.
D. Install units with Security Film in accordance with Film manufacturer’s recommendations with Impact Protection Attachment Sealant against film.

3.08 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements for additional requirements.
B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
C. Monitor and report installation procedures and unacceptable conditions.

3.09 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
B. Remove nonpermanent labels immediately after glazing installation is complete.
C. Clean glass and adjacent surfaces after sealants are fully cured.
D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.10 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

DIVISION 08 87 23 – SAFETY AND SECURITY FILM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glazing film applied to new glazing assemblies.
B. New Glazing: Factory or shop install film to glazing before installation in frames.
C. Glazing assemblies to receive film are indicated on drawings.

1.02 RELATED REQUIREMENTS

A. *Division 08 11 13* - Hollow Metal Doors and Frames: New doors with glazing to receive film.
B. *Division 08 41 00* - Aluminum-Framed Storefronts
C. *Division 08 44 13* - Glazed Aluminum Curtain Walls: New glazing to receive film.
D. *Division 08 80 00* - Glazing: New glazing to received film.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.
C. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2023.
D. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2012.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Record of product certification for safety requirements.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.
C. Shop Drawings: Detailing installation of film, anchoring accessories, and sealant.
D. Samples: For each film product to be used, minimum size 4 inches by 6 inches, representing actual product, color, and patterns.
E. Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies identical to those required for this project.
F. Specimen Warranty.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Glazing film manufacturer specializing in manufacture of safety glazing films with minimum 10 years' successful experience.
B. Installer Qualifications: Certified by glazing film manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturers for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 WARRANTY

A. See *Section 01 78 00* - Closeout Submittals, for additional warranty requirements.
B. Provide 10-year manufacturer's replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: 3M Window Film; Ultra 800: www.solutions.3m.com/#sle.
B. Avery Dennison; Safety and Security Films: www.averydennison.com/#sle.
C. Flexvue Films: www.flexvuefilms.com/#sle.
D. Impact Security, LLC: www.defenselite.com/#sle.
E. Madico, Inc: www.madico.com/#sle.
F. XPEL, Inc: www.xpel.com/#sle.
G. Approved Equal.
H. Substitutions: See *Section 01 60 00* - Product Requirements.

2.02 SAFETY AND SECURITY GLAZING FILM

A. Safety Glazing: New glazing assemblies to provide impact resistance complying with ANSI Z97.1 and 16 CFR 1201, Category II.
   1. 1/4-inch-thick clear annealed glass.
   2. Surface applied film.
   3. Requiring no supplemental anchoring devices.

2.03 MATERIALS

A. Glazing Film: Transparent polyester film for permanent bonding to glass.
   1. Thickness: 0.008-inch, minimum.
   2. Color: Clear.
   3. Construction: Micro-layered.
   4. Adhesive: Pressure sensitive acrylic.
   5. Tensile Strength: 31,500 psi minimum when tested in accordance with ASTM D882.
   6. Breaking Strength: 253 psi when tested in accordance with ASTM D882.
   7. Graves Tear Resistance: 1,075 lbs %.
   8. Spontaneous Breakage in accordance with ASTM E1886.

B. Accessory Materials: As recommended or required by film manufacturer.

C. Attachment System: Manufacturer's Impact Protection Attachment System.

D. Sealant: Film Manufacturer's recommended impact protection attachment (IPA) sealant.

E. Glass Cleaner: As recommended by glazing film manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine glass and frames. Verify that existing conditions are adequate for proper application and performance of film.

B. Verify glass is not cracked, chipped, broken, or damaged.

C. Verify that frames are securely anchored and free of defects.

3.02 PREPARATION

A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.

B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.

C. Protect adjacent surfaces.

D. Do not begin installation until substrates have been properly prepared.

3.03 INSTALLATION

A. Do not apply glazing film when surface temperature is less than 40 degrees F or if precipitation is imminent.

B. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.

C. Accurately cut film with straight edges to required sizes allowing 1/16 inch to 1/8-inch gap at perimeter of glazed panel unless otherwise required by anchorage method.

D. Seams: Seam film only as required to accommodate material sizes; form seams vertically without overlaps and gaps; do not install with horizontal seams.

E. Supplemental Anchors / Sealants: Install manufacturer's impact protection attachment sealant in accordance with manufacturer's instructions and shop drawings.

F. Clean glass and anchoring accessories following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.

G. Remove labels and protective covers.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

DIVISION 08 91 00 – LOUVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Louvers, frames, and accessories.

1.02 RELATED REQUIREMENTS

A. *Division 07 42 13* - Metal Wall Panels: Adjacent wall cladding for color selection.
B. *Division 07 42 13.23* – Metal Composite Material Wall Panels: Adjacent wall cladding for color selection.
C. *Division 07 92 00* - Joint Sealants: Sealing joints between frames and adjacent construction.
D. *Division 23 31 00* - HVAC Ducts and Casings: Ductwork attachment to louvers and blank-off panels.

1.03 REFERENCE STANDARDS

A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High-Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
F. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.
D. Samples: Submit two samples 2 by 2 inches in size illustrating finish and color of exterior and interior surfaces.
E. Test Reports: Independent agency reports showing compliance with specified performance criteria.
F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
G. Maintenance Data: Include lubrication schedules, adjustment requirements.
H. Prior to the delivery of any materials to the job site, submit copies of technical data and shop drawings to the Architect/Engineer for approval. No materials shall be delivered to the job site until the submittals have been approved in writing by the Architect/Engineer. Contractor shall submit free area pressure drop and water penetration curves.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals for additional warranty requirements.
B. Provide five-year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
    1. Finish: Include coverage against degradation of exterior finish.

1.07 DELIVERY, STORAGE AND HANDLING

A. Products shall be shipped and stored in manufacturer’s original, unopened cartons. Store items in safe protected areas prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

1. Airolite Company, LLC: www.airolite.com.
2. Construction Specialties, Inc: www.c-sgroup.com.
3. Greenheck; ESD Drainable Blade Louver with blade trough and downspout concealed in jamb: www.greenheck.com.
4. Pottorff: www.pottorff.com.
5. Ruskin Company: www.ruskin.com/#sle.
6. Approved Equal.
7. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 STATIONARY BLADE LOUVERS

A. Basis of Design Model: ELF445DX as manufactured by Ruskin Company.

B. Fabrication:

1. Design: Stationary drainable louver type with drain gutters in each blade and head with downspouts in jambs and mullions with all welded construction. Hidden vertical supports to allow continuous line appearance up to 120 inches (3,048 mm). Steeply angled integral sill.
2. Frame:
   a. Frame Depth: 4 inches (102 mm).
   b. Wall Thickness: 0.081 inch (2.1 mm), nominal.
   c. Material: Extruded aluminum, Alloy 6063-T6.
3. Blades:
   a. Style: Drainable. 45 degrees at 4 inches (102 mm), nominal.
   b. Wall Thickness: 0.081 inch (2.1 mm), nominal.
   c. Material: Extruded aluminum, Alloy 6063-T6.

C. Performance Data:

1. Based on testing 48 inch x 48 inch (1,219 mm x 1,219 mm) size unit in accordance with AMCA 500.
2. Free Area: 52 percent, nominal.
3. Free Area Size: 8.34 square feet (0.77 m2).
4. Maximum Recommended Air Flow through Free Area: 1075 feet per minute (5.46 m/s).
5. Air Flow: 8966 cubic feet per minute (4.23 m^3/s).
6. Maximum Pressure Drop (Intake): 0.225 inches w.g. (56 Pa).
7. Water Penetration: Maximum of 0.01 ounces per square foot (3.1 g/m2) of free area at an air flow of 1075 feet per minute (5.46 m/s) free area velocity when tested for 15 minutes.

D. Design Windload: Per Code.

E. Louvers shall be factory engineered to withstand the specified seismic loads.

1. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).

2.03 STORM SHELTER STATIONARY BLADE LOUVERS

A. Basis of Design Model: XP500WD as manufactured by Ruskin Company.

B. Fabrication: Extruded Aluminum stationary horizontal double drainable sight proof louver style.

1. Frame:
   a. Frame Depth: 5 1/2 inches (140 mm).
   b. Wall Thickness: 0.25 inches (6 mm), nominal.
   c. Material: Extruded aluminum.
2. Blades:
   a. Style: Horizontal mounted double drainable sight proof.
   b. Wall Thickness: 0.188 inch (4.78 mm), nominal.
   c. Material: Extruded aluminum.

C. Performance Data:

1. Free Area: 28 percent, nominal.
2. Maximum Recommended Air Flow through Free Area: 1250 feet per minute (6.35 m/sec).
3. Wind Driven Water Penetration Performance:
   a. Based on testing 39 inches x 39 inches (1 m x 1 m) core area, 42 inches x 42 inches (1.06 m x 1.06 m) nominal size unit in accordance with AMCA 500-L.
   b. Wind Velocity: 29 mph (47 kph).

c. Rainfall Rate: 3 inches/hour (76 mm/hour).
d. Free Area Velocity: 1949 feet per minute (9.9 m/s).
e. Water Resistance Effectiveness: 99.8% (AMCA Class A).

4. Pressure Drop (Intake): at 1000 fpm 0.09 inches w.g. (0.22 kPa). (Exhaust) 0.14 inches w.g. (.03 kPa) exhaust

D. Design
1. Designed Windload:
a. 300 PSF: 78 inches high (1981 mm).
2. Louvers shall be factory engineered to withstand the specified seismic loads.
a. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).
B. Formed Aluminum: Formed sheet, ASTM B209/B209M.
C. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

2.05 FINISHES

A. High-Performance Organic Coatings: AAMA 2604; multiple coats, thermally cured fluoropolymer system.
B. Pigmented Organic Coatings: AAMA 2603; polyester or acrylic baked enamel finish.
C. Primer: Zinc chromate, alkyd type.
D. Color: Selected by Architect to match adjacent wall cladding or as otherwise indicated on drawings. Custom match MCM-1 where louvers are installed within Metal Composite Material Wall Panels.

2.06 ACCESSORIES

A. Blank-Off Panels: Same material as louver, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
B. Blank-Off Panels: Aluminum face and back sheets, polyisocyanurate foam core, 1-1/2 inch thick, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
C. Blank-Off Panels: See Section 23 3100.
D. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.
E. Bird Screen: Interwoven wire mesh of steel, 14-gauge, 0.0641-inch diameter wire, 1/2-inch open weave, diagonal design.
F. Insect Screen: 18 x 16 size aluminum mesh.
G. Fasteners and Anchors: Galvanized steel.
H. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.
I. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared openings and flashings are ready to receive this work, and opening dimensions are as indicated on shop drawings.
B. Verify that field measurements are as indicated.

3.02 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.
B. Coordinate with installation of flashings by others.
C. Install louvers level and plumb.
D. Set sill members and sill flashing in continuous bead of sealant.
E. Align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
F. Secure louver frames in openings with concealed fasteners.
G. Coordinate with installation of mechanical ductwork.
H. Coordinate with installation of louver actuators.

3.03 ADJUSTING

A. Adjust operable louvers for freedom of movement of control mechanism. Lubricate operating joints.

3.04 CLEANING

A. Strip protective finish coverings.
B. Clean surfaces and components.
C. Adjacent wall surfaces and materials shall be protected during installation. Any damaged adjacent materials shall be repaired or replaced at no cost to Owner.
D. Upon completion of the accessory installation, remove from the job site all excess materials and debris and leave ready for final inspection.

DIVISION 09 00 00 – GENERAL FINISH REQUIREMENTS

FINISHES: The Owner's approval for all selections is required. The Architect shall assist the Owner in coordinating furniture colors with the approved color schedule. Finishes selected shall be durable, easily cleaned, and easily repeatable when it becomes necessary to renew or refinish. The use of paint graphics or applied graphics should be kept simple and reproducible by ordinary painters or printing company.

PHYSICAL EDUCATION FINISHES: Masonry or similar damage-resistant material with an easily cleanable finish is required. Painted exposed structure is acceptable above, but acoustic treatments should be considered due to the size of the space required, generally acoustical deck and panels or acoustical banners. Floor finish at the elementary level should be resilient flooring with the game lines inlayed. Middle School and High School gyms shall have sprung maple athletic floors.

TYPICAL FINISHES:

Room or Area	Floors	Base	Walls	Ceiling	Special Notes
Typical Classroom including Music and Art Rooms	LVT (1)	4" Rubber Cove	Satin Latex	ACT	Carpet tile where floor electrical boxes are present. VCT for budget constraints.
Typical Office and Conference Rooms	Carpet Tile	4" Rubber Cove	Eggshell Latex	ACT	Carpet tile where floor electrical boxes are present.
Clinic, Workrooms, Storage Rooms	LVT (1)	4" Rubber Cove	Satin Latex	ACT	Carpet tile where floor electrical boxes are present.
Band Room	LVT (1) or hard floor	4" Rubber Cove	Satin Latex	ACT	Include Acoustical wall panels.
Playroom	LVT (1)	4" Rubber Cove	Satin Latex	Painted Structure	Include Acoustical wall panels, use MSCS playroom layout.
Platform	LVT (1)	4" Rubber Cove	Satin Latex	ACT	Do not use concrete to create elevation change. Stage curtains included in construction

Gymnasium	Wood	Rubber Cove (3)	Satin Latex	Painted Structure	Use TSSAA painted lines
Stage	Wood	Rubber Cove (3)	Satin Latex	Painted Structure	Stage curtains included in construction
Auditorium	Carpet Tile aisles, sealed concrete seating area	4" Rubber Cove	Satin Latex	ACT	Include Acoustical wall panels.
Library	Carpet Tile	4" Rubber Cove	Satin Latex	ACT	Other flooring may be acceptable if approved by MSCS DFM
Kitchen	Quarry Tile	Quarry Tile Cove	Epoxy or Acrylic Latex	Washable ACT with hold down clips	Cementitious urethane floor finish to be an alternate
Serving	Quarry Tile, Terrazzo, or LVT (1)	Quarry Tile or Rubber Base Cove	Epoxy	ACT	Depending on design, choose appropriate flooring and base installation
Cafeteria	Terrazzo or LVT (1)	4" Rubber Cove	Satin Latex	ACT	Include Acoustical Wall Panels.
Staff Bathrooms	Ceramic Tile (2)	Ceramic Tile Cove (2)	Epoxy or Acrylic Latex	ACT	
Classroom Toilets	Ceramic Tile (2)	Ceramic Tile Cove (2)	Epoxy or Acrylic Latex	ACT	
Group Toilets	Ceramic Tile (2)	Ceramic Tile Cove (2)	Epoxy or Acrylic Latex	ACT (4)	Ceramic Tile on wet walls to top of partitions.
Corridors - school	Terrazzo or LVT (1)	4" Rubber Cove	Satin Latex	ACT	Provide colored stripes in flooring for Elementary Schools
Corridors - admin	Carpet Tile	4" Rubber Cove	Eggshell Latex	ACT	
Vestibules	Terrazzo, LVT & walk off carpet mats	4" Rubber Cove	Satin Latex	ACT	Walk-off carpet tiles within 10' of entry door.
Elevators	LVT (1)	none	Laminate	Luminous Ceiling	
Stairs in Elementary	LVT landings (1)	4" Rubber Cove	Satin Latex	ACT	Use one-piece rubber stair tread and riser cover

Stairs in Middle and High	Sealed Concrete	4" Rubber Cove	Satin Latex	ACT	Metal stair nosing
Custodian Closets	Sealed Concrete	4" Rubber Cove	Epoxy		FRP to 4' behind floor sinks.
Mechanical, Electrical, IDF & other utility spaces	Sealed Concrete	none	none		Paint plywood backboards flat black.

(1) LVT - Consult with MSCS PM on maintenance requirements and performance criteria.
(2) Provide Cove Base. 12 x 12 tiles with minimal grout tiles preferred.
(3) Use rubber base with expansion leg designed for wood sports floor.
(4) Specify hold down clips on ACT in Group Toilets.

DIVISION 09 05 61 – FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile.
   2. Carpet tile.
   3. Thin-set ceramic tile.
B. Preparation of new concrete floor slabs for installation of floor coverings.
C. Testing of concrete floor slabs for moisture and alkalinity (pH).
D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
E. Patching compound.
F. Remedial floor coatings.
G. Remedial floor sheet membrane.

1.02 RELATED REQUIREMENTS

A. *Division 01 22 00* - Unit Prices: Bid pricing for remediation treatments if required.
B. *Division 01 23 00* - Alternates: Bid pricing for remediation treatments if required.
C. *Division 01 40 00* - Quality Requirements: Additional requirements relating to testing agencies and testing.
D. *Division 03 30 00* - Cast-in-Place Concrete: Concrete admixture for slabs to receive adhered flooring, to prevent moisture content-related flooring failures.
E. *Division 03 30 00* - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.
F. *Division 03 54 00* - Cast Underlayment: Self-leveling underlayment applied as remediation treatment.

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices: See *Division 01 22 00* - Unit Prices.
B. Unit Price for Alternate Flooring Adhesive: Do not include the cost of the alternate adhesive in the base bid; state on the bid form the unit price per square foot for using the alternate adhesive, in the event such remediation is required.
   1. Base the unit price on a total quantity calculated by assuming that only 50 percent of the flooring will require the alternate adhesive.
C. Unit Price for Remedial Floor Coating or Sheet Membrane: Do not include the cost of the floor coating or underlayment in the base bid; state on the bid form the unit price per square foot for the floor coating or underlayment, installed, in the event such remediation is required.
   1. Base the unit price on a total quantity calculated by assuming that only 50 percent of the

flooring will require the alternate adhesive.

1.04 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.
B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.
C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2018.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.06 SUBMITTALS

A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.
B. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   4. Copies of specified test methods.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Include certification of accuracy by authorized official of testing agency.
   7. Submit report to Architect/Engineer.
   8. Submit report not more than two business days after conclusion of testing.
C. Adhesive Bond and Compatibility Test Report.
D. Copy of RFCI (RWP).
E. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
   1. Manufacturer's qualification statement.
   2. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
   3. Manufacturer's installation instructions.
   4. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

1.07 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
B. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.
C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
D. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.
   5. Notify Architect/Engineer when specified ambient conditions have been achieved and when testing will start.
E. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at

least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
B. Deliver materials in manufacturer's packaging; include installation instructions.
C. Keep materials from freezing.

1.09 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
   1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
   2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
   3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
   4. Products:
      a. ARDEX Engineered Cements; ARDEX Feather Finish: www.ardexamericas.com/#sle.
      b. TEC, an H.B. Fuller Construction Products Brand; TEC Feather Edge Skim Coat: www.tecspecialty.com/#sle.
      c. USG Corporation; Durock Brand Advanced Skim Coat Floor Patch: www.usg.com/#sle.
      d. Approved Equal.
      e. Substitutions: See Section 01 6000 - Product Requirements.
B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
   1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
   2. Products:
      a. ARDEX Engineered Cements; ARDEX MC RAPID: www.ardexamericas.com/#sle.
      b. Floor Seal Technology, Inc; MES 100 with Floor Seal FloorCem SLU: www.floorseal.com/#sle.
      c. LATICRETE International, Inc; LATICRETE SUPERCAP Moisture Vapor Control with LATICRETE SUPERCAP Underlayment: www.laticrete.com/#sle.
      d. Proflex Products, Inc; Moisture Barrier 25 with DPU - Deep Pour Underlayment: www.proflex.us/#sle.
      e. Sika Corporation; Sikafloor Moisture Tolerance Epoxy Primer and Sikafloor Self-Leveling Moisture Tolerant Resurfacer: www.sikafloorusa.com/#sle.
      f. Approved Equal.
      g. Substitutions: See *Division 01 60 00* - Product Requirements.
D. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
   1. Thickness: 28 mil (0.028 inch).

2. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.
3. Products:
    a. GCP Applied Technologies; Kovara MBX: www.gcpat.com/#sle.
    b. Approved Equal.
    c. Substitutions: See *Division 01 60 00* - Product Requirements.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency.
B. Perform following operations in the order indicated:
    1. Preliminary cleaning.
    2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
    3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
    4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
    5. Specified remediation, if required.
    6. Patching, smoothing, and leveling, as required.
    7. Other preparation specified.
    8. Adhesive bond and compatibility test.
    9. Protection.
C. Remediations:
    1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
    2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
    3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
B. Do not use solvents or other chemicals for cleaning.

3.03 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflicts with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. Test in accordance with ASTM F1869 and as follows.
C. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
D. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
E. Report: Report on the information required by the test method.

3.04 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflicts with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. Test in accordance with ASTM F2170 Procedure A and as follows.
C. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test

values and do not quantify the moisture content sufficiently.

D. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

E. Report: Report on the information required by the test method.

3.05 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflicts with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.

1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.

C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with requirements and recommendations of floor covering manufacturer.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

3.09 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

A. Install in accordance with sheet membrane manufacturer's instructions.

3.10 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

DIVISION 09 29 00 – GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

Confine the use of abuse resistant 5/8" gypsum board partitions to administration and non-student "support" areas. These areas include Principal's office, Assistant Principal's office, support services' offices and all conference rooms shall be constructed to provide an STC rating of at least 54. Metal studs and abuse resistant gypsum wallboard with ¼" plywood backup can be used in other areas when approval of the Project Manager. MSCS prefers abuse resistant and mold/ mildew resistant 5/8" gypsum board for the ceiling finish in middle and high school complexes. Mold/mildew resistant gypsum boards shall be used in all wet areas such as toilets, janitor's closet, locker rooms, showers, kitchens, etc.

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Acoustic insulation.

E. Gypsum sheathing.

F. Cementitious backing board.

G. Gypsum wallboard.

H. Joint treatment and accessories.

I. Plenum space sound control.

J. Glass mat faced gypsum board.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.
B. *Division 05 40 00* - Cold-Formed Metal Framing: Structural steel stud framing.
C. *Division 06 10 00* - Rough Carpentry: Wood blocking product and execution requirements.
D. *Division 07 27 00* - Air Barriers: Air and vapor barrier over sheathing.
E. *Division 07 84 00* - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
F. *Division 07 92 00* - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).
C. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
D. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
E. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
F. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
I. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
J. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
K. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
L. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board; 2004 (Reapproved 2020).
M. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
N. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
O. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
P. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.
Q. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.
R. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
S. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
T. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
U. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
V. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2017.
W. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018 (Reapproved 2023).
X. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).
Y. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
Z. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior

Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2023.

AA. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).

BB. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

CC. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.

DD. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

EE. ASTM E413 - Classification for Rating Sound Insulation; 2016.

FF. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

GG. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.

HH. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2019.

II. GA-600 - Fire Resistance and Sound Control Design Manual; 2021.

JJ. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

KK. UL (FRD) - Fire Resistance Directory; current edition.

LL. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

MM. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide data on metal framing, gypsum board, accessories, and joint finishing system.

C. Steel Framing Industry Association (SFIA) Certification:
   1. Submit documentation that metal studs and connectors used on project meet or exceed requirements of International Building Code.

D. Product Data: Provide data on specified products, including adhesives and sealants, describing physical and performance characteristics.

E. Test Reports: For stud framing products that do not comply with AISI S220 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

F. Steel Stud Manufacturers Association (SSMA) Manufacturer Qualification: Submit documentation of manufacturer association membership.

G. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

A. SFIA Code Compliance Certification Program: www.CFSteel.org/#sle: Use metal studs and connectors certified for compliance with International Building Code.

B. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

D. Documents at Project Site: Maintain at the project site a copy of manufacturer's instructions, erection drawings, and shop drawings.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

B. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Interior Partitions, Indicated as Sound-Rated: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 50-54 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
   2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

D. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions in accordance with ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
   1. Authorities Having Jurisdiction.

E. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216.

F. Fire-Resistance-Rated Assemblies: Provide completed assemblies complying with applicable code.
   1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.
   2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
   3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

B. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. Basis of Design: ClarkDietrich: www.clarkdietrich.com/#sle.
   2. Jaimes Industries: www.jaimesind.com/#sle.
   3. Marino: www.marinoware.com/#sle.
   4. SCAFCO Corporation: www.scafco.com/#sle.
   5. Steel Construction Systems: www.steelconsystems.com/#sle.
   6. Approved Equal.
   7. Substitutions: See *Division 01 60 00* - Product Requirements.

C. Structural Steel Framing for Application of Gypsum Board: See Section 05 4000.

D. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf. Where wall tile will be used as finish material, use L/360 at 5 psf.
   1. Studs: C-shaped with flat faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.
   4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
   5. Resilient Furring Channels: Single or double leg configuration; 1/2-inch channel depth.

E. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.

F. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

G. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.

H. Non-structural Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
      a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
      b. Height: 35-3/4 inches unless wall height is indicated to be less than 36 inches on drawings.
   3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

I. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. Basis of Design: USG Corporation: www.usg.com/#sle.
   2. American Gypsum Company: www.americangypsum.com/#sle.
   3. CertainTeed Corporation: www.certainteed.com/#sle.
   4. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
   5. Gold Bond Buiilding Products, LLC provided by National Gypsum Company: www.goldbondbuilding.com/#sle.
   6. Approved Equal.
   7. Substitutions: See Section 01 6000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
      a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
   3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Thickness:
      a. Vertical Surfaces: 5/8 inch.
      b. Ceilings: 5/8 inch.
      c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
   5. Paper-Faced Products:
      a. Basis of Design: USG Corporation; Sheetrock Brand Firecode X Panels 5/8 in: www.usg.com/#sle.
      b. American Gypsum Company; FireBloc Type X Gypsum Wallboard: www.americangypsum.com/#sle.
      c. CertainTeed Corporation; Type X Drywall: www.certainteed.com/#sle.
      d. Georgia-Pacific Gypsum; ToughRock Fireguard X: www.gpgypsum.com/#sle.
      e. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond Fire-Shield C 5/8" Gypsum Board: www.goldbondbuilding.com/#sle.
      f. Approved Equal.
   6. Mold-Resistant, Paper-Faced Products:
      a. Basis of Design: USG Corporation; Sheetrock Brand EcoSmart Panels Mold Tough Firecode X 5/8 in: www.usg.com/#sle.
      b. American Gypsum Company; M-Bloc Type X: www.americangypsum.com/#sle.
      c. CertainTeed Corporation; M2Tech 5/8" Type X Moisture & Mold Resistant Drywall: www.certainteed.com/#sle.
      d. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard: www.gpgypsum.com/#sle.
      e. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Gypsum Board: www.goldbondbuilding.com/#sle.
      f. Approved Equal.

C. Abuse Resistant Wallboard:
   1. Application: High-traffic areas indicated.
   2. Surface Abrasion: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
   3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   4. Soft Body Impact: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   5. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   6. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
   7. Glass Mat-Faced Type: Gypsum wallboard, as defined in ASTM C1658/C1658M.
   8. Unfaced Type: Interior fiber-reinforced gypsum panels, as defined in ASTM C1278/C1278M.
   9. Type: Fire-resistance-rated Type X, UL or WH listed.
   10. Thickness: 5/8 inch.
   11. Edges: Tapered.
   12. Paper-Faced Products:
      a. Basis of Design: USG Corporation; Sheetrock Brand Mold Tough AR Firecode X 5/8 in: www.usg.com/#sle.
      b. American Gypsum Company; M-Bloc AR Type X: www.americangypsum.com/#sle.
      c. CertainTeed Corporation; Extreme Abuse Resistant Drywall with M2Tech: www.certainteed.com/#sle.
      d. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold Guard Abuse-Resistant: www.gpgypsum.com/#sle.
      e. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Hi-Abuse Gypsum Board: www.goldbondbuilding.com/#sle.
      f. Approved Equal.
   13. Glass Mat Faced Products:
      a. Basis of Design: USG Corporation; Sheetrock Brand Glass-Mat Panels Mold Tough AR Firecode X 5/8 in: www.usg.com/#sle.
      b. Georgia-Pacific Gypsum; DensArmor Plus Abuse-Resistant: www.gpgypsum.com/#sle.
      c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Interior Extreme AR Gypsum Panel: www.goldbondbuilding.com/#sle.
      d. Approved Equal.

D. Impact Resistant Wallboard:
   1. Application: High-traffic areas indicated.
   2. Surface Abrasion: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   4. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   5. Hard Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
   6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   7. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
   8. Glass Mat-Faced Type: Gypsum wallboard, as defined in ASTM C1658/C1658M.
   9. Unfaced Type: Interior fiber-reinforced gypsum panels, as defined in ASTM C1278/C1278M.
   10. Type: Fire-resistance-rated Type X, UL or WH listed.
   11. Thickness: 5/8 inch.
   12. Edges: Tapered.
   13. Paper-Faced Products:
      a. Basis of Design: USG Corporation; Sheetrock Brand Mold Tough VHI Firecode X Panels 5/8 in: www.usg.com/#sle.
      b. American Gypsum Company; M-Bloc IR Type X: www.americangypsum.com/#sle.
      c. CertainTeed Corporation; Extreme Impact Resistant Drywall with M2Tech: www.certainteed.com/#sle.

d. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Hi-Impact Gypsum Board: www.goldbondbuilding.com/#sle.
e. Approved Equal.

14. Glass Mat Faced Products:
    a. Basis of Design: USG Corporation; Sheetrock Brand Glass-Mat Panels Mold Tough VHI Firecode X 5/8 in: www.usg.com/#sle.
    b. Georgia-Pacific Gypsum; DensArmor Plus Impact-Resistant: www.gpgypsum.com/#sle.
    c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Interior Extreme IR Gypsum Panel: www.goldbondbuilding.com/#sle.
    d. Approved Equal.

E. Backing Board For Wet Areas:
1. Application: Surfaces behind tile in wet areas including restroom walls.
2. Application: Horizontal surfaces behind tile in wet areas including countertops.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
    a. Thickness: 5/8 inch.
    b. Products:
        1) Basis of Design: USG Corporation; Fiberock Brand Aqua-Tough AR Interior Panels Regular 5/8 in: www.usg.com/#sle.
        2) PermaBASE Building Products, LLC provided by National Gypsum Company; PermaBase Cement Board: www.goldbondbuilding.com/#sle.
        3) Approved Equal.
5. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
    a. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch.
    b. Products:
        1) Basis of Design: USG Corporation; Durock Brand Glass-Mat Tile Backerboard SGX 5/8 in: www.usg.com/#sle.
        2) CertainTeed Corporation; 5/8" GlasRoc Tile Backer Type X: www.certainteed.com/#sle.
        3) Georgia-Pacific Gypsum; DensShield Tile Backer: www.gpgypsum.com/#sle.
        4) Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Tile Backer: www.goldbondbuilding.com/#sle.
        5) Approved Equal.

F. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Type X Thickness: 5/8 inch.
4. Edges: Tapered.
5. Products:
    a. Basis of Design: USG Corporation; Durock Brand Glass-Mat Tile Backerboard SGX 5/8 in: www.usg.com/#sle.
    b. American Gypsum Company; M-Bloc Type X: www.americangypsum.com/#sle.
    c. Georgia-Pacific Gypsum; ToughRock Mold-Guard Gypsum Board: www.gpgypsum.com/#sle.
    d. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board: www.goldbondbuilding.com/#sle.
    e. Approved Equal.

G. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Fungal Resistance: No fungal growth when tested in accordance with ASTM G21.
4. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM

C1177/C1177M.
5. Core Type: Type X, as indicated.
6. Type X Thickness: 5/8 inch.
7. Edges: Square.
8. Glass Mat Faced Products:
    a. Basis of design: USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing Firecode X 5/8 in: www.usg.com/#sle.
    b. American Gypsum Company; M-Glass Exterior Sheathing Type X: www.americangypsum.com/#sle.
    c. CertainTeed Corporation; GlasRoc Type X Exterior Sheathing: www.certainteed.com/#sle.
    d. Georgia-Pacific Gypsum; DensGlass Fireguard Sheathing: www.gpgypsum.com/#sle.
    e. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Sheathing: www.goldbondbuilding.com/#sle.
    f. Approved Equal.

H. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
2. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Paper-Faced Products:
    a. Basis of Design: USG Corporation; Sheetrock Brand Mold Tough Gypsum Liner Panels 1 in SLX: www.usg.com/#sle.
    b. American Gypsum Company; M-Bloc Shaft Liner: www.americangypsum.com/#sle.
    c. CertainTeed Corporation; M2Tech Type X Shaftliner: www.certainteed.com/#sle.
    d. Georgia-Pacific Gypsum; ToughRock Shaftliner: www.gpgypsum.com/#sle.
    e. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond Shaftliner XP: www.goldbondbuilding.com/#sle.
    f. Approved Equal.
5. Glass Mat Faced Products:
    a. Basis of Design: USG Corporation; Sheetrock Brand Glass-Mat Liner Panels Mold Tough 1 in: www.usg.com/#sle.
    b. American Gypsum Company; M-Glass Shaft Liner: www.americangypsum.com/#sle.
    c. CertainTeed Corporation; GlasRoc Shaftliner Type X: www.certainteed.com/#sle.
    d. Georgia-Pacific Gypsum; DensGlass Shaftliner (mold-resistant): www.gpgypsum.com/#sle.
    e. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Shaftliner: www.goldbondbuilding.com/#sle.
    f. Approved Equal.

2.04 PLENUM SPACE SOUND CONTROL

A. Manufacturers:
1. Basis of Design: AcoustiGuard – WILREP LTD; Privacy Board and Return-Air Silencers: www.acoustiguard.com/#sle.
2. Rockfon: www.rockfon.com
3. Approved Equal.
4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Description: Acoustical extension wall board for noise control within ceiling plenums above wall partitions.

C. General Requirements:
1. Airstream surfaces installed in return air plenum to comply with requirements in ASHRAE Std 62.1.
2. Factory-fabricated, field-installed products.

D. Configuration: As indicated on drawings.

E. Materials:
   1. Mineral Fiber Insulation Board:
      a. Surface Burning Characteristics: Flame spread/smoke development index of 0/0 when tested in accordance with ASTM E84 or UL 723.
   2. Scrim Reinforced Foil Facing:
      a. Surface Burning Characteristics: Flame spread/smoke development index of 5/20 when tested in accordance with ASTM E84 or UL 723.
   3. Nonwoven Fiberglass Facing:
      a. Flammability: V-0 when tested in accordance with UL 94.
   4. Return-Air Silencer:
      a. Fabricate in accordance with SMACNA (DCS) HVAC Duct Construction Standards.
      b. Provide return-air silencer on both sides of privacy board.
      c. Dimensions: As indicated on drawings.
      d. Outer Housing: 28 gauge, 0.0149 inch galvanized steel.
      e. Mineral Fiber Insulation Board: 2 inch thick insulation board with flame spread/smoke development index of 0/0 when tested in accordance with ASTM E84 or UL 723.
F. Rating:
   1. Equivalent STC: Per SMACNA (DCS).
   2. Static Pressure Drop at 500 fpm Face Velocity: Per SMACNA (DCS) inches wg.

2.05 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: Full depth of stud unless otherwise indicated on Drawings.
B. Acoustic Putty: QuietPutty 380 or equivalent.
   1. Type: Noise damping putty.
   2. Thickness: 1/8 inch (3.17 mm).
   3. Weight: 6 oz pad.
   4. Density: 1oz/cu. in.
   5. Tensile Strength (ASTM D412): 135 PSI.
   6. TCA Robinson test (ASTM C627): Light Commercial.
C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
   1. Products:
      a. Basis of Design: Franklin International, Inc; Titebond Acoustical Smoke & Sound Sealant: www.titebond.com/#sle.
      b. Liquid Nails, a brand of PPG Architectural Coatings: www.liquidnails.com/#sle.
      c. Specified Technologies Inc; Smoke N Sound Acoustical Sealant: www.stifirestop.com/#sle.
      d. Approved Equal.
      e. Substitutions: See *Division 01 60 00* - Product Requirements.
D. Air Barrier: See Section 07 2700.
E. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.
   2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
   3. Products:
      a. Basis of Design: Phillips Manufacturing Co: www.phillipsmfg.com/#sle.
      b. Stockton Products: www.stocktonproducts.com/#sle.
      c. Trim-tex, Inc: www.trim-tex.com/#sle.
      d. Approved Equal.
      e. Substitutions: See *Division 01 60 00* - Product Requirements.
F. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
   1. Corner Beads: Low profile, for 90 degree outside corners.
      a. Products:
         1) Basis of Design: Phillips Manufacturing Co; Everlast Corner Bead:

www.phillipsmfg.com/#sle.
2) CertainTeed Corporation; No-Coat Drywall Corner: www.certainteed.com/#sle.
3) ClarkDietrich; Strait-Flex OS-300: www.clarkdietrich.com/#sle.
4) Trim-Tex, Inc: www.trim-tex.com/#sle.
5) Approved.
6) Substitutions: See *Division 01 60 00* - Product Requirements.

2. L-Trim with Tear-Away Strip: Sized to fit 1/2-inch thick gypsum wallboard.
   a. Products:
      1) Basis of Design: Phillips Manufacturing Co; gripSTIK L-Tear: www.phillipsmfg.com/#sle.
      2) Trim-Tex: www.trim-tex.com/#sle
      3) Approved Equal.
      4) Substitutions: See *Division 01 60 00* - Product Requirements.
3. Architectural Reveal Beads:
   a. Reveal Depth: 1/2 inch.
   b. Reveal Width: 1/2 inch.
   c. Shapes: As indicated on drawings.
   d. Products:
      1) Basis of Phillips Manufacturing Co; J-400 Reveal Trim: www.phillipsmfg.com/#sle.
      2) Trim-Tex, Inc: www.trim-tex.com/#sle.
      3) Approved Equal.
      4) Substitutions: See Section 01 6000 - Product Requirements.
4. Wall Mounted Deflection Beads: Flexible gasket and bead with 1-1/8-inch flange.
   a. Products:
      1) Basis of Design: Phillips Manufacturing Co; www.phillipsmfg.com/#sle.
      2) Trim-Tex, Inc: www.trim-tex.com/#sle.
      3) Approved Equal.
      4) Substitutions: See *Division 01 60 00* - Product Requirements.
5. Expansion Joints:
   a. Type: V-shaped metal with factory-installed protective tape.
   b. Type: Off-angle inside corner expansion.
   c. Products:
      1) Basis of Design: Phillips Manufacturing Co; 093 Expansion Control Joint: www.phillipsmfg.com/#sle.
      2) Trim-Tex, Inc: www.trim-tex.com/#sle.
      3) Approved Equal.
      4) Substitutions: See *Division 01 60 00* - Product Requirements.

G. Decorative Metal Trim:
   1. Material: Extruded aluminum alloy 6063-T5 temper.
   2. Finish: Anodized, clear.
   3. Type: Profile as selected from manufacturer's standard range.
      a. Products:
         1) Basis of Design: Gordon Inc: www.gordon-inc.com/#sle.
         2) Pittcon Industries: www.pittconindustries.com/#sle.
         3) Tamlyn: www.tamlyn.com/#sle.
         4) Approved Equal.
         5) Substitutions: See *Division 01 60 00* - Product Requirements.

H. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   2. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
   3. Joint Compound: Drying type, vinyl-based, ready-mixed.
   4. Joint Compound: Setting type, field-mixed.

I. Finishing Compound: Surface coat and primer, takes the place of skim coating.

J. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
K. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
L. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.
M. Nails for Attachment to Wood Members: ASTM C514.
N. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
O. Adhesive for Attachment to Wood, ASTM C557 and Metal:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
   1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
   2. Install studs at spacing required to meet performance requirements.
B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.
   1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
   2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.03 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.
B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Level ceiling system to a tolerance of 1/1200.
   2. Laterally brace entire suspension system.
   3. Install bracing as required at exterior locations to resist wind uplift.
C. Studs: Space studs at 16 inches on center, or as required by stud manufacturer’s limiting heights.
   1. Extend partition framing 1. Extend partition framing to structure where indicated and to 6 inches minimum above ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
   1. Orientation: Horizontal.
   2. Spacing: As indicated.
F. Furring for Fire-Resistance Ratings: Install as required for fire-resistance ratings indicated and to GA-600 requirements.
G. Blocking: Install wood blocking for support of:
   1. Framed openings.
   2. Wall-mounted cabinets.
   3. Plumbing fixtures.
   4. Toilet partitions.
   5. Toilet accessories.
   6. Wall-mounted door hardware.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
B. Acoustic Putty Pads: Install in accordance with manufacturer's instructions at all electrical boxes installed in metal framed walls with acoustic insulation.
C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
    1. Place one bead continuously on substrate before installation of perimeter framing members.
    2. Place continuous bead at perimeter of each layer of gypsum board.
    3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
    1. Exception: Tapered edges to receive joint treatment at right angles to framing.
C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
F. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
    1. Seal joints, cut edges, and holes with water-resistant sealant.
    2. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.
G. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
    1. Seal joints, cut edges, and holes with water-resistant sealant.
H. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
I. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.
J. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For nonrated assemblies, install as follows:
    1. Single-Layer Applications: Adhesive application.
    2. Double-Layer Application: Install base layer using screws or nails. Install face layer using adhesive.
K. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
    1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
    2. At exterior soffits, not more than 30 feet apart in both directions.
B. Corner Beads: Install at external corners, using longest practical lengths.
C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.
E. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations indicated on drawings. Provide vent area specified.

3.07 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and

finish with drying type joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
   2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   3. Level 3: Walls to receive textured wall finish.
   4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   5. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
   6. Level 0: Temporary partitions.
   7. Level 0: Surfaces indicated to be finished in later stage of project.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
   2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
   3. Taping, filling, and sanding are not required at base layer of double-layer applications.

E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.09 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

DIVISION 09 30 00 – TILE WORK

PART 1 GENERAL

WATER COOLER ALCOVES: specify a tile or other waterproof floor finish (not VCT) underneath unit and within standing zone. Each location should include a unit designed for accessibility.

MAINTENANCE STOCK: At time of completing installation, deliver stock of maintenance material to Owner. Furnish amount equal to 5% or one box, whichever is greater, of each type and color of units installed.

TILE SIZES AND SHAPES: Use coved bases and bullnose pieces on corners. Limit use of mosaic tiles.
GROUT AND SEALER: Use Epoxy Grout. For quarry tile use a black or other dark color grout. Other colors must be approved by the Owner.

ALUMINUM EDGING AND CORNER GUARDS: Shall be provided at doorways of entrances of toilet rooms.
QUARRY TILE: Flashed color ranges are recommended. Slip resistance is essential. Provide moisture barrier under all ceramic and quarry tile floors above first level.

WALL TILE & WALL LIGHTING: Designer is to coordinate lighting fixture locations and minimize the use of wall sconce light fixtures on walls with tile finish to eliminate excessive shadowing between tile faces and grout lines.

In the months of July and August prior to the start of Teacher's return, the Contractor is responsible for cleaning and waxing of floors by a MSCS approved custodial vendor to ensure that the facility is ready to receive students and staff in preparation for start of school. Including movement of furniture out of areas of work and back into work areas. Coordinate and schedule cleaning efforts with MSCS custodial staff.

1.01 SECTION INCLUDES

A. Tile for floor applications.
B. Tile for wall applications.
C. Coated glass mat backer board as tile substrate.

D. Ceramic trim.
E. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.
B. *Division 07 05 43* - Cladding Support System.
C. *Division 09 21 16* - Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.
B. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2019).
I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
L. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.
M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).
N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.
O. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2013 (Revised).
P. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2023.
Q. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).
R. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
S. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).
T. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
U. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
V. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete

Subfloor Using Anhydrous Calcium Chloride; 2023.

W. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

X. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.

D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Installer's Qualification Statement:

1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.
2. Submit documentation of completion of apprenticeship and certification programs.

G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See *Division 01 60 00* - Product Requirements, for additional provisions.
2. Extra Tile: 1 percent or 10 square feet, whichever is greater, of each size, color, and surface finish combination.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

B. Installer Qualifications:

1. Company specializing in performing tile installation, with minimum of five years of documented experience.
    a. Accredited Five-Star member of the National Tile Contractors Association (NTCA) or Trowel of Excellence member of the Tile Contractors' Association of America (TCAA).
2. Installer Certification:
    a. Apprenticeship Program: Installer has achieved Journey worker status through an apprenticeship from the International Union of Bricklayers and Allied Craftworkers (IUBAC) or a U.S. Department of Labor (DOL)-recognized program.
    b. Advanced Certifications for Tile Installers (ACT): Certification in the installation of membranes, mortar bed (mud) floors, mortar (mud) walls, shower receptors, large format tile, gauged porcelain tile/panels/slabs, and grouts.
    c. International Masonry Training and Education Foundation (IMTEF): Supervisor Certification Program (SCP).

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers:

1. Basis of Design as indicated on drawings.

B. Glazed Porcelain Tile, Type T-1, T-2, T-3, T-4, T-5, T-6, T-8 : ANSI A137.1 standard grade.

1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
2. Size: As indicated on drawings.
3. Color(s): As indicated on drawings.

C. Color Body Porcelain Tile, Type ART-1—ANSI A137.1 standard grade.

1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.

2. Breaking Strength: >300 lbs as tested in accordance with ASTM C648.
3. Chemical Resistance: Resistant as tested in accordance with ASTM C650.
4. Size: As indicated on drawings.
5. Color(s): As indicated on drawings.

D. Quarry Tile, Type T-7: ANSI A137.1 standard grade.
1. Moisture Absorption: 0.5 to 3.0 percent as tested in accordance with ASTM C373.
2. Breaking Strength: >350 lbs. as tested in accordance with ASTM C648.
3. Scratch Hardness: 7 as tested in accordance with ASTM MOHS.
4. Chemical Resistance: Resistant as tested in accordance with ASTM C650.
5. Surface Finish: Abrasive.
6. Color(s): As indicated on drawings.

E. Ceramic Trim: Matching cove base in sizes coordinated with field tile.
1. Applications:
a. Floor to Wall Joints: Cove base.

F. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
1. Applications:
a. Open edges of wall and floor tile.
b. Outside wall corners.
c. Transition between floor finishes of different heights.
d. Floor and wall expansion and control joints.
e. Borders and other trim as indicated on drawings.
2. Products:
a. Basis of Design: Schluter-Systems: www.schluter.com/#sle.
b. Genesis APS International: www.genesis-aps.com/#sle.
c. Approved Equal.
d. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
1. Applications: Use this type of mortar where indicated and where no other type of grout is indicated.
2. Products:
a. Basis of Design: LATICRETE International, Inc; LATICRETE LATAPOXY 300 Adhesive: www.laticrete.com/#sle.
b. Custom Building Products; EBM-Lite Epoxy Bonding Mortar: www.custombuildingproducts.com/#sle.
c. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy: www.merkrete.com/#sle.
d. Sika Corp; SikaTile 350 Flex Set: www.sika.com/#sle.
e. Approved Equal.
f. Substitutions: See *Division 01 60 00* - Product Requirements.

C. Polymer fortified Large and Heavy Tile Mortar:
1. Applications: Exterior Tiling.
2. Products:
a. Basis of Design: LATICRETE International, Inc; LATICRETE MULTIMAX LITE Adhesive: www.laticrete.com/#sle.
b. Custom Building Products; www.custombuildingproducts.com/#sle.
c. Merkrete, by Parex USA, Inc; www.merkrete.com/#sle.
d. Sika Corp; www.sika.com/#sle.
e. Approved Equal.
f. Substitutions: See *Division 01 60 00* - Product Requirements.

2.03 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
1. Applications: Use this type of grout where indicated and where no other type of grout is is indicated.

2. Color(s): As indicated on drawings.
3. Products:
    a. Basis of Design: LATICRETE International, Inc: LATICRETE SPECTRALOCK PRO Premium Grout: www.laticrete.com/#sle.
    b. ARDEX Engineered Cements; ARDEX WA: www.ardexamericas.com/#sle.
    c. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout: www.custombuildingproducts.com/#sle.
    d. H.B. Fuller Construction Products, Inc; TEC AccuColor EFX Epoxy Special Effects Grout: www.tecspecialty.com/#sle.
    e. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy: www.merkrete.com/#sle.
    f. Sika Corp; SikaTile 825 Epoxy: www.sika.com/#sle.
    g. Approved Equal.
    h. Substitutions: See *Division 01 60 00* - Product Requirements.

2.04 MAINTENANCE MATERIALS

A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
    1. Applications: Between tile and plumbing fixtures.
    2. Color(s): As selected by Architect/Engineer from manufacturer's full line.
    3. Products:
        a. ARDEX Engineered Cements; ARDEX SX: www.ardexamericas.com/#sle.
        b. LATICRETE International, Inc; LATICRETE LATASIL: www.laticrete.com/#sle.
        c. Approved Equal.
        d. Substitutions: See Section 01 6000 - Product Requirements.

B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
    1. Composition: Water-based acrylic.
    2. Products:
        a. Basis of Design: STONETECH, a Division of LATICRETE International, Inc; STONETECH Heavy Duty Grout Sealer: www.laticrete.com/#sle.
        b. Merkrete, by Parex USA, Inc; Merkrete Revive: www.merkrete.com/#sle.
        c. Approved Equal.
        d. Substitutions: See Section 01 6000 - Product Requirements.

C. Tile Sealer: Stain protection for porcelain tile.
    1. Products:
        a. Basis of Design: STONETECH, a Division of LATICRETE International, Inc; STONETECH BulletProof Stone Sealer: www.laticrete.com/#sle.
        b. Custom Building Products; Aqua Mix Enrich 'N' Seal: www.custombuildingproducts.com/#sle.
        c. Rust-Oleum Corporation; Miracle Sealants 511 Impregnator Natural Looking Penetrating Sealer: www.rustoleum.com/#sle.
        d. Approved Equal.
        e. Substitutions: See *Division 01 60 00* - Product Requirements.

2.05 ACCESSORY MATERIALS

A. Waterproofing Membrane: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
    1. Locations: tile floors at toilet rooms and kitchens, tile floors and walls at showers,
    2. Crack Resistance: No failure at 1/16-inch gap, minimum; comply with ANSI A118.12.
    3. Fluid or Trowel Applied Type:
        a. Material: Synthetic rubber or Acrylic.
        b. Thickness: 25 mils, minimum, dry film thickness.
        c. Products:
            1) Basis of Design: LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com/#sle.
            2) ARDEX Engineered Cements; ARDEX 8+9: www.ardexamericas.com/#sle.
            3) Custom Building Products; RedGard Crack Prevention and Waterproofing Membrane: www.custombuildingproducts.com/#sle.

4) H.B. Fuller Construction Products, Inc; TEC HydraFlex Waterproofing Crack Isolation Membrane: www.tecspecialty.com/#sle.
5) Merkrete, by Parex USA, Inc; Merkrete Hydro Guard 1: www.merkrete.com/#sle.
6) Sika Corp; SikaTile 100 Moisture Guard: www.sika.com/#sle.
7) Approved Equal.
8) Substitutions: See *Division 01 60 00* - Product Requirements.

B. Air and Water Barrier (Exterior): Specifically designed for bonding to vertical cementitious substrate under mortar or thin-set tile, complying with ANSI A118.10.
1. Crack Resistance: No failure at 1/16-inch gap, minimum; comply with ANSI A118.12.5.4.
2. Brush, roller or trowel applied Type:
a. Material: Synthetic rubber or Acrylic.
b. Thickness: 25 mils, minimum, dry film thickness.
c. Permeability: greater than 1.0 perms
3. Products:
a. Basis of Design: LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com/#sle.
b. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
c. Approved Equal.
d. Substitutions: See *Division 01 60 00* - Product Requirements.

C. Backer Board (Exterior): Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 5/8 inch thick; 2-inch-wide coated glass fiber tape for joints and corners.
1. Products: Refer to Section 09 2116 - Gypsum Board Assemblies.

D. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
1. Fire Resistant Type: Type X core, thickness 5/8 inch.
2. Products: Refer to Section 09 2116 - Gypsum Board Assemblies.

E. Mesh Tape: 2-inch-wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
1. Test as Follows:
a. Alkalinity (pH): ASTM F710.
b. Internal Relative Humidity: ASTM F2170.
c. Moisture Vapor Emission: ASTM F1869.
2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
1. Follow moisture and alkalinity remediation procedures in Section 09 0561.

B. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

A. Install tile and grout in accordance with applicable requirements of ANSI A108.1a through ANSI

A108.19 , manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
E. Form internal angles square and external angles bullnosed.
F. Install non-ceramic trim in accordance with manufacturer's instructions.
G. Sound tile after setting. Replace hollow sounding units.
H. Keep control and expansion joints free of mortar, grout, and adhesive.
I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F131, epoxy bond coat and grout, unless otherwise indicated.
B. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.05 INSTALLATION - FLOORS - MORTAR BED METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F132, epoxy bond coat and grout, unless otherwise indicated.
B. Waterproofing Membrane: Install as recommended by manufacturer and as specified in the section in which the product is specified.
C. Mortar Bed Thickness: 5/8 inch, unless otherwise indicated.

3.06 INSTALLATION - WALL TILE

A. On exterior walls install in accordance with TCNA (HB) Method W244, thin-set over cementitious backer units, with waterproofing membrane.
B. Over masonry or concrete, Install in accordance with TCNA (HB) Method W202I44, using membrane at toilet rooms.
C. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

3.07 CLEANING

A. Clean tile and grout surfaces.

3.08 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

DIVISION 09 51 00 – ACOUSTICAL CEILINGS AND PANELS

PART 1 GENERAL

MAINTENANCE STOCK: At time of completing installation, deliver required attic stock to Owner. Furnish amount equal to 5% or one box, whichever is greater, of each type, size, and color of acoustical units installed.
ACOUSTIC CEILING PANELS: Provide manufacturer's standard lay-in panels, 24" x 24" grid-size panels, with white non-directional finish. Panels shall have an NRC rating of .70 to 1.00 or higher. Provide non-sag panels if using 24” x 48” ceiling panels. Tegular edge tiles are discouraged. Designers shall use higher NRC rated tile for spaces requiring additional sound attenuation such as Band and Music Rooms. Use hold-down clips in Group Toilets, entry vestibules and other areas of security concern.

ABUSE RESISTANT PANELS: Provide (along with hold-down clips) at areas where damage might be expected, such as Elementary School PE Rooms.
PANELS: 3/4" thick cane or wood fiber panels are acceptable in corridors and multi-purpose rooms. Do not use soft acoustical panels at low ceiling installations. Tectum is not acceptable.

ACOUSTICAL CEILING TILE GRID SYSTEM & HANGERS: Designer shall specify that all wire hangers avoid contact with all duct insulation. When applicable, wire hangers shall be fastened to the low web profile of metal decking above so as not to penetrate roof system. All classrooms shall have ceiling grid system visually noted for fixed walls and freestanding as required for seismic events. Ceiling grid system shall be installed according to the manufacturer’s instructions and recommendations.

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.
B. Acoustical units.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
C. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
D. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
E. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.
F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting of Work of this section.
B. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
C. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
C. Product Data: Provide data on suspension system components and acoustical units.
D. Evaluation Service Reports: Show compliance with specified requirements.
E. Samples: Submit two samples 6 by 6 inch in size illustrating material and finish of acoustical units.
F. Samples: Submit two samples each, 12 inches long, of suspension system main runner, cross runner, and perimeter molding.
G. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Extra Acoustical Units: Quantity equal to 5 percent of total installed, of each type.

1.06 QUALITY ASSURANCE

A. Designer Qualifications for Seismic Design: Perform under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
B. Fire-Resistive Assemblies: Complete assembly listed and classified by UL (FRD) for the fire resistance indicated.
C. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.
D. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.

1.07 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.08 DELIVERY, STORAGE AND HANDLING

A. Care shall be taken in handling all portions of the ceiling during transportation and at the job site. All material must arrive at the job site packed in heavy, unopened cartons bearing the manufacturer's labels. Store material under cover, in a dry location and in a manner to prevent damage. Broken, chipped or cracked panels will not be installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Basis of Design: Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
   2. CertainTeed Corporation: www.certainteed.com/#sle.
   3. USG Corporation: www.usg.com/ceilings/#sle.
   4. Approved Equal.
   5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Suspension Systems:
   1. Same manufacturer as for acoustical units.

1.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
   1. Local authorities having jurisdiction.

1.02 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Fire Class A.
   1. Units for installation in Fire-Rated Suspension System: Listed and classified for the fire-resistive assembly as part of suspension system.

B. Acoustical Panels, Type A1: Mineral fiber with the following characteristics:
   1. Classification: ASTM E1264 Type III.
      a. Form: 2, water felted.
      b. Pattern: CE.
   2. Size: 24 by 24 inches.
   3. Thickness: 3/4 inch.
   4. Light Reflectance: 0.82 percent, determined in accordance with ASTM E1264.
   5. NRC: 0.70, determined in accordance with ASTM E1264.
   6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
   7. Tile Edge: Square.
   8. Color: White.
   9. Suspension System Type SS-1: Exposed grid.
   10. Products:
      a. Basis of Design: Armstrong World Industries, Inc; School Zone; Fine Fissured 1713: : www.armstrongceilings.com/#sle.
      b. Certainteed Architectural; Cashmere: www.certainteed.com/ceilings-and-walls/#sle.
      c. USG Corporation; Radar Acoustical Panels No. 2220: www.usg.com/ceilings/#sle.
      d. Approved Equal.
      e. Substitutions: See *Division 01 60 00* - Product Requirements.

C. Acoustical Panels, Type A2: Mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264 Type III.
      a. Form: 2, water felted.
      b. Pattern: CE. As indicated on drawings
   2. Size: 24 by 24 inches.
   3. Thickness: 5/8 inch.
   4. Light Reflectance: 0.82 percent, determined in accordance with ASTM E1264.
   5. NRC: 0.55, determined in accordance with ASTM E1264.
   6. Ceiling Attenuation Class (CAC): 33, determined in accordance with ASTM E1264.
   7. Panel Edge: Square.
   8. Color: White.
   9. Suspension System Type SS-1: Exposed grid.
   10. Products:
      a. Basis of Design: Armstrong World Industries, Inc; Fine Fissured 1728; www.armstrongceilings.com/#sle.
      b. USG Corporation: www.usg.com/ceilings/#sle.
      c. Certain Teed; www.certainteed.com/ceilings-and-walls/#sle..
      d. Approved Equal.

e. Substitutions: See *Division 01 60 00* - Product Requirements.

D. Acoustical Panels, Type A3: Mineral Fiber with the following characteristics:
1. Classification: ASTM E1264 Type IX.
   a. Form: 2, water felted.
   b. Pattern: "G" - smooth.
2. Size: 24 by 24 inches.
3. Thickness: 5/8 inches.
4. Light Reflectance: 0.89 percent, determined in accordance with ASTM E1264.
5. NRC: N/A, determined in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 33, determined in accordance with ASTM E1264.
7. Panel Edge: Square.
8. Color: White.
9. Suspension System Type SS-1: Exposed grid.
10. Products:
    a. Basis of Design: Armstrong World Industries, Inc; Kitchen Zone 673; www.armstrongceilings.com/#sle.
    b. USG Corporation: www.usg.com/#sle.
    c. Certainteed Architectural; www.certainteed.com/ceilings-and-walls/#sle..
    d. Approved Equal.
    e. Substitutions: See *Division 01 60 00* - Product Requirements.

E. Acoustical Panels, Type A4: Mineral fiber, with the following characteristics:
1. Classification: ASTM E1264 Type IV.
   a. Form: 2, water felted.
   b. Pattern: "E" - lightly textured.
2. Size: 24 by 24 inches.
3. Thickness: 5/8 inch.
4. Light Reflectance: 0.80 percent, determined in accordance with ASTM E1264.
5. NRC: .65, determined in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
7. Panel Edge: Beveled Tegular.
8. Color: White.
9. Suspension System Type SS-1: Exposed grid.
10. Products:
    a. Basis of Design: Armstrong World Industries, Inc; Canyon 1492; www.armstrongceilings.com/#sle.
    b. USG Corporation: www.usg.com/ceilings/#sle.
    c. Certainteed Architectural; www.certainteed.com/ceilings-and-walls/#sle...
    d. Approved Equal.
    e. Substitutions: See *Division 01 60 00* - Product Requirements.

F. Acoustical Panels: Type ACP-1: Mineral fiber with the following characteristics:
1. Classification: ASTM E1264 Type IV.
   a. Form: 2, water felted.
   b. Pattern: E.
2. Size: 24 by 48 inches.
3. Thickness: 3/4 inch.
4. NRC: .75, determined in accordance with ASTM E1264.
5. Tile Edge: Square.
6. Color: As indicated in drawings.
7. Mounting: D-20.
8. Products:
    a. Basis of Design: Armstrong World Industries, Inc; Invisacoustics 1212; www.armstrongceilings.com/#sle.
    b. USG Corporation: www.usg.com/#sle.
    c. Approved Equal.
    d. Substitutions: See *Division 01 60 00* - Product Requirements.

1.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
   1. Materials:
      a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

B. Exposed Suspension System, Type SS-1: Hot-dipped galvanized steel grid.
   1. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
   2. Profile: Tee; 15/16-inch-wide face.
   3. Finish: White baked polyester paint .
   4. Products:
      a. Basis of Design: Armstrong World Industries, Inc; Prelude XL 15/16": www.armstrongceilings.com/#sle.
      b. Certainteed Architectural; 15/16" EZ Stab Classic System: www.certainteed.com/ceilings-and-walls/#sle.
      c. USG Corporation; Donn Brand, DXL26, 15/16" Tee System: www.usg.com/ceilings/#sle.
      d. Approved Equal.
      e. Substitutions: See *Division 01 60 00* - Product Requirements.

1.04 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
C. Hold-Down Clips: Manufacturer's standard clips to suit application.
D. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.
E. Perimeter Moldings: Same metal and finish as grid.
   1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
   2. Channel Molding: U-shaped, for hold-down type installations.
   3. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.
F. Metal Edge Trim for Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
   1. Trim Height: As indicated on Drawings.
   2. Color: White.
G. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that layout of hangers will not interfere with other work.

2.02 PREPARATION

A. Install after major above-ceiling work is complete.
B. Coordinate the location of hangers with other work.

2.03 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
C. Locate system on room axis according to reflected plan.
D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Overlap and rivet corners.
E. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4-inch clearance between grid ends and wall.
F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest

affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
I. Do not eccentrically load system or induce rotation of runners.

2.04 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.
B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
C. Lay directional patterned units with pattern parallel to longest room axis.
D. Fit border trim neatly against abutting surfaces.
E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
F. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.
   3. Double cut and field paint exposed reveal edges.
G. Where round obstructions and bullnose concrete block corners occur, provide preformed closures to match perimeter molding.
H. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
I. Install hold-down clips on panels within 20 ft of an exterior door.

2.05 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

2.06 CLEANING

A. See *Division 01 70 00* - Execution and Closeout Requirements for additional requirements.
B. Clean surfaces.
C. Replace damaged or abraded components.

DIVISION 09 64 00 – WOOD FLOORING

STAGE/ PLATFORM FLOORING: Manufacturer's standard straight edge, tongue and groove and end-matched solid wood flooring, 1" thick x 2 1/8" or 2 1/4" strips in standard random lengths. Use Southern Pine, type C and better flooring, near-rift grain with flat black paint finish. Use resilient flooring at elementary schools.

Finish wood stage flooring with a transparent polyurethane finish. The polyurethane shall be installed as per the wood flooring supplier and system manufacturer.

ATHLETIC FLOORING: At high and middle schools use manufacturer's standard straight edge tongued and grooved and end matched solid wood flooring, $^{25}/_{32\text{-inch-thick}}$ x 2 ¼" strips, 2'0" minimum length and averaging 4'-6" long, double channeled base, or plain sawn, second and better grade, MFMA Grade marked, Northern Hard Maple with transparent polyurethane finish. Specify manufacturer's resilient pads over concrete subfloor with manufacturer's recommended plywood subfloor and vapor barrier. Specify Connor Duracushion I as basis of design. Electrical, including low voltage, connections and volleyball court insert locations need to be field verified prior to installation. Vent cove base needs to be included in the installation. Court graphics to be reviewed with school staff and MSCS PM. Allowances for court graphics shall be included in base bid. Athletic floor finish shall have an elevation differential of no greater than ½" or as code/ ADA guidelines allow.

Demolition and replacement of existing varsity gymnasium maple wood floor.
Demolition of all VCT floor surrounding and touching wood floor and replace with wood floor throughout gym area.
Installation of a new MFMA 2nd grade or better maple floor system with a complete and functioning system.
Replacement of all existing game lines and logos, including all other sports items.
Replace logo in 12' jump circle with new logo to be sent from MSCS.
Installation of a new 10 mil polyethylene vapor barrier. (Vapor barrier must meet staygo standards)

Removal of existing perimeter wood floor cove base in all cases.
Installation of new maple wood floor perimeter venter cove base to match existing. (Must do mock-up for approval)
Removal of existing door thresholds and replacement of door thresholds, including walk-off mats at exterior doors and rubber/vinyl mats at interior doors.
All exterior doors must be waterproof around all opening frames.
Provide new aluminum transition strips through existing door and cased openings Match thickness and size of existing. (Zinc strip)
New hinged brass cover plates shall be installed to cover existing volleyball inserts. Prep gym floor to receive new volleyball sleeves. Size shall match existing
Refinish new maple wood floor per MFMA standards for complete and functioning system.
Replacement of HVAC system filters upon completion of project. Must maintain correct humidity levels during construction.
Readjust new floor to regulation height. All basketball goals must match new flooring.
New floor striping shall meet TSSAA guidelines in all cases.
Readjust basketball goals to regulation height
Replacement of all power/outlets/low voltage/connections on the court.
Attic stock for maintenance cleaners and complete closeouts.
Flatness/test/control moisture levels prior to removal of new floor in all cases. Levels of control would be:

Floor flatness
Moisture readings in slab on grade
Sleeper installs
Moisture testing air quality and floor moisture

Contractor is responsible for all or any water intrusion for complete and functioning system in all cases.

DIVISION 09 65 00 – RESILIENT FLOORING

PART 1 GENERAL

Preferred type of tile flooring is no strip, no wax Luxury Vinyl Tile (LVT). Other acceptable types of tile flooring are Rubber Tile, and Vinyl Tile goods. Colors shall be standard colors. Premium and custom colors are discouraged. Designers shall include a high moisture content adhesive as part of the base bid in the project documents.

WALL BASE: Rubber or Vinyl Cove. Specify roll products at maximum lengths available to minimize the numbers of joints. Design to specify installation with rounded pre-molded outside corners. Colors shall be standard colors. Premium and custom colors are discouraged.
For each type of product required, including adhesives, cleaning compounds, and other accessories, provide the same product by one manufacturer throughout the project and specify that all products have low VOC's.
For Luxury Vinyl Tile (LVT), use premium product lines of the following manufacturers, provided they comply with requirements of the contract documents and have a low VOC:

- Armstrong Flooring
- Shaw Contract
- Tarkett
- Approved equal.

It is recommended to not use solid colors without modeled chip patterns nor very light or dark colors of VCT for floor installations.

For wall base, products are to be low VOC.
RUBBER ACCESSORIES: Stairs in elementary schools to have one-piece rubber stair tread and riser cover. In high Schools and Middle Schools use exposed concrete with metal tread nosing.

1.01 SECTION INCLUDES

A. Resilient tile flooring.
B. Resilient base.
C. Installation accessories.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.
B. *Division 09 05 61* - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.03 REFERENCE STANDARDS

A. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.
B. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Shop Drawings: Indicate seaming plans and floor patterns.
D. Verification Samples: Submit two samples, 12 by 12 inches in size illustrating color and pattern for each resilient flooring product specified.
E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
G. Manufacturer's Qualification Statement.
H. Installer's Qualification Statement.
I. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Extra Tile Flooring Material: One box for every 50 boxes of installed tiles.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years' documented experience.
B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience and approved by flooring manufacturers.
C. Testing Agency Qualifications: Independent firm specializing in performing concrete slab moisture testing and inspections of the type specified in this section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
B. Store all materials off of the floor in an acclimatized, weather-tight space.
C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
D. Protect roll materials from damage by storing on end.
E. Do not double stack pallets.

1.07 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 TILE FLOORING

A. Vinyl Tile - Type LVT-1, LVT-2, LVT-3, LVT-4, LVT-5: Printed film type, with transparent or translucent wear layer; acoustic interlayer or backing.
    1. Manufacturers:
        a. Basis of Design: Tarkett Luxury Vinyl Tile; www.commercial.tarkett.com..
        b. Mannington Commercial: www.manningtoncommercial.com#sle.
        c. Approved Equal.
        d. Substitutions: See *Division 01 60 00* - Product Requirements.
    2. Minimum Requirements: Comply with ASTM F1700, Class III.
    3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648.
    4. Size: As indicated on drawings.
    5. Wear Layer Thickness: 20 mil (0.5 mm).

6. Color: As indicated on drawings.

B. Rubber Tile - Type RBT-1, RBT-2: Homogeneous, color and pattern throughout thickness.
   1. Manufacturers:
      a. Basis of Design: Tarkett Rubber Tile; www.commercial.tarkett.com..
      b. Mannington Commercial: www.manningtoncommercial.com#sle.
      c. Approved Equal.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
   3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   4. Size: As indicated on drawings.
   5. Texture: As indicated on drawings.
   6. Color: As indicated on drawings.

2.02 STAIR COVERING

A. Stair Treads with Integral Risers - Type RBST-01: Rubber; full height of riser, full width and depth of tread in one piece; tapered thickness.
   1. Manufacturers:
      a. Basis of Design: Tarkett Luxury Vinyl Tile; www.commercial.tarkett.com..
      b. Mannington Commercial: www.manningtoncommercial.com#sle.
      c. Approved Equal.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Minimum Requirements: Comply with ASTM F2169, Type TS, rubber, vulcanized thermoset.
   3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   4. Striping: 2 inch wide contrasting color abrasive strips.
   5. Tread Texture: As indicated on drawings.
   6. Color: As indicated on drawings.

2.03 RESILIENT BASE

A. Resilient Base - Type WB-1: ASTM F1861, Type TP, rubber, thermoplastic; style as scheduled.
   1. Manufacturers:
      a. Basis of Design: Tarkett; www.commercial.tarkett.com.
      b. Mannington Commercial: www.manningtoncommercial.com#sle.
      c. Approved Equal.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Height: 4 inches.
   3. Thickness: 0.125 inch.
   4. Finish: Satin.
   5. Length: Roll.
   6. Color: As indicated on drawings.

B. Resilient Base - Type WB-2: ASTM F1861, Type TS rubber, vulcanized thermoset; style as scheduled.
   1. Manufacturers:
      a. Basis of Design: Tarkett; www.commercial.tarkett.com.
      b. Mannington: www.manningtoncommercial.com
      c. Approved Equal.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Height: 4 inches.
   3. Thickness: 0.125 inch.
   4. Finish: Satin.
   5. Length: Roll.
   6. Color: As indicated on drawings.

2.04 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring

manufacturers.

C. Moldings, Transition and Edge Strips: Same material as flooring.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturers, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).

1. Test in accordance with *Division 09 05 61*.
2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
3. Follow moisture and alkalinity remediation procedures in *Division 09 05 61*.

3.02 PREPARATION

A. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

B. Prohibit traffic until filler is fully cured.

C. Clean substrate.

D. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Adhesive-Applied Installation:

1. Spread only enough adhesive to permit installation of materials before initial set.
2. Fit joints and butt seams tightly.
3. Set flooring in place, press with heavy roller to attain full adhesion.

D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

G. At movable partitions, install flooring under partitions without interrupting floor pattern.

3.04 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.05 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.06 INSTALLATION - STAIR COVERINGS

A. Install stair coverings in one piece for full width and depth of tread.

B. Adhere over entire surface. Fit accurately and securely.

3.07 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.08 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

DIVISION 09 65 66 – GYM FLOORING

PART 1 GENERAL

1.01 DESCRIPTION

A. Related work specified under other sections.
   1. *Division 03 30 00* - Cast-in-Place Concrete
      a. Concrete Slab Depression: 2 1/4" with 25/32” Flooring and continuous subfloor
      b. Surface Finish: steel troweled and finished smooth.
      c. Concrete Tolerance: 1/8” (3mm) in radius of 10’ (3m).
      d. Compressive Strength: Concrete shall be a minimum of 3,000 psi (21 MPa) and a maximum of 4000 psi (28MPa) compressive strength after 28 days.
   2. Concrete slab aggregate shall be ¾” screen crushed limestone or similar type material (no river gravel or pea gravel)< free of curing agents. Concrete shall develop an average or 3,500 PSI compression after 28 days.
   3. *Division 03 05 00* - Underslab Vapor Barrier:
      a. Concrete subfloors on or below grade shall be adequately waterproofed beneath the slab and at the perimeter walls and on the earth side of below grade walls by general contractor using suitable type membrane.
   4. *Division 11 66 23* - Gymnasium Equipment
      a. Install volleyball sleeves. Coordinate with General Contractor.

1.02 REFERENCES

A. MFMA - Maple Flooring Manufacturers Association
B. DIN - Performance Standard DIN 18032, Part 2

1.03 QUALITY ASSURANCE

A. Floor System Manufacturer Qualifications
   1. Manufacturer of resilient flooring shall be a firm specializing in manufacturing products specified in this section.
   2. Manufacturer of flooring and subfloor components must be ISO 9001:2008 Certified to assure quality control of materials provided.
   3. Manufacturer of gymnasium floor system and hardwood flooring surface shall be verified as a “Zero Waste” company confirmed through SWCA third-party auditing.
   4. Basis of design shall be “Alliance” sports floor system as provided by Connor Sports Flooring, www.connorfloor.com, (800-833-7144).
   5. Materials other than those listed must be approved 10 days prior by written addendum. Materials from non-approved manufacturers will not be accepted.
B. Floor Contractor/Installer Qualifications and Certifications
   1. The complete installation of the flooring system, as described in the scope of these specifications, shall be carried out by the MFMA Mill Accredited Installation Company, and the work shall be performed in accordance with most recent installation instructions of the manufacturer.
   2. The MFMA Mill Accredited Installation Company shall be liable for all matters related to installation for a period of one year after the floor has been substantially installed and completed.
C. Performance Testing
   1. Flooring system shall have been independently tested and meets or exceeds all Athletic Performance requirements according to the International Standard DIN 18032, Part 2
   2. Independent DIN testing laboratory shall have Scientific Body Membership in the International Association of Sports Surface Sciences (ISSS).
   3. DIN testing engineer shall be an ISO 17025 System member rated for each performed test conducted.
   4. Flooring system shall have been independently tested and evaluated for Engineering Performance according to the Structural Testing and Engineering Measures (STEM).

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Specification - Submit Connor Alliance specification sheets.
C. Sample - Submit one sample of specified system, if requested by architect.

D. Maintenance Literature - Upon completion of floor installation, send to owner, attendants or individuals in charge and responsible for the upkeep of the building a CARE CARD. This card spells out care and maintenance instructions including temperature and humidity ranges for areas where flooring is installed.

1.05 WORKING CONDITIONS

A. The wood flooring specified herein shall not be installed until all masonry, painting, plaster, and tile work is completed, and overhead mechanical trades and painters have finished in the wood floor areas. The building shall be enclosed and weathertight.

B. The concrete subfloor shall be determined dry by industry standard testing procedures, free of foreign materials and turned over to the installer (Flooring Contractor) broom clean. Moderate room temperature of 65 degrees or more shall be maintained a week preceding and throughout the duration of the work. Humidity conditions within the building shall approximate the humidity conditions that will prevail when the building is occupied.

C. Permanent heat, light and ventilation shall be installed and operating during and after installation, maintaining a range of temperature and humidity compatible with the expected low and high moisture content of the flooring. The wood moisture content range is determined by the Flooring Installer based on the facility's mechanical controls and/or geographical location.

D. Flooring must be stored in a dry, well-ventilated area, not in contact with masonry, to acclimate to building conditions and shall be installed at moisture content compatible with the normally expected environmental range of temperature and relative humidity achieved while the facility is occupied.

E. General Contractor shall lock floor area after floor is finished to allow proper curing time. If general contractor or owner requires use of gym after proper curing time, he shall protect the floor by covering with non-marring kraft paper or red rosin paper with taped joints until acceptance by owner of complete gymnasium floor.

F. Working conditions as described above shall be followed. Variations and substitutions shall be submitted for approval to the architect who shall advise Connor of the same.

1.06 HUMIDITY CONTROL

A. Since all wood flooring will expand and contract as relative humidity varies, it is important to minimize extremes between low and high. Hardwood flooring is manufactured at moisture content most compatible with a 35%-50% relative humidity range. Geographical regions and available mechanicals determine the typical range of temperature and humidity for each facility. Maintaining a 15% fluctuation between highest and lowest average indoor relative humidity provides limited shrinkage and growth. Facility managers should make use of available HVAC systems to prevent excessive tightening and shrinkage of flooring.

1.07 WARRANTY

A. Connor warrants that the materials it has supplied will be free from manufacturing defects for a period of one year. The foregoing warranty is in lieu of and excludes all other warranties not expressly set forth herein, whether express or implied in operation of law or otherwise, including, but not limited to, and implied warranties of merchantability or fitness. This warranty is expressly limited to the flooring materials (goods) supplied by Connor. This warranty does not cover floor damage caused (wholly or in part) by fire, winds, floods, moisture, other unfavorable atmospheric conditions or chemical action, nor does it apply to damage caused by ordinary wear, misuse, abuse, negligent or intentional misconduct, aging, faulty building construction, concrete slab separation, faulty or unsuitable subsurface or site preparation, settlement of the building walls or faulty or unprofessional installation of Connor flooring systems.

B. Connor shall not be liable for incidental or consequential losses, damages or expenses directly or indirectly arising from the sale, handling or use of the materials (goods) or from any other cause relating thereto, and their liability hereunder in any case is expressly limited to the replacement of materials (goods) not complying with this agreement, or at their elections, to the repayment of, or crediting buyer with, an amount equal to the purchase price of such materials (goods), whether such claims are for breach of warranty or negligence. Any claim shall be deemed waived by buyer unless submitted to Connor in writing within 30 days from the date buyer discovered, or should have discovered, any claimed breach.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturers
   1. Basis of Design: Connor Sports Flooring; "Alliance" sports floor system: www.connorfloor.com.
   2. Approved Equal.
   3. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Subfloor
   1. Alliance I - Factory assembled subfloor panels shall provide nominal 3/4" X 4" X 8' UL plywood nailers set at Alliance I spacing with 3/4" Rezill pads attached. Sleeper anchorage struts shall be nominal 1/2" X 4" UL grade plywood with pre-drilled anchor pockets.

C. Flooring (Connor Laytite Maple)
   1. 25/32" X 2-1/4", Second & Better Grade, Northern Hard Maple Flooring, TGEM, MFMA Grade marked and stamped as manufactured by Connor Sports Flooring, Amasa, MI.
   2. Manufactured flooring profile shall include 1/64" side edge crush bead.

D. Fasteners
   1. Flooring - 2" barbed cleats or coated staples.
   2. Subfloor - 1" coated staples or nails and PL400 adhesive or equal.
   3. Concrete - 2-1/2", collared, steel drive pins.

E. Finishing Materials
   1. Connor oil modified polyurethane seal and finish or equal.

F. Game Lines
   1. Game line paint shall be compatible with finish.
   2. Game lines include main court, three-point arc and free-throw line on (2) secondary courts, and volleyball court.
   3. Main basketball court paint to include 3' wide sides, 5' wide ends paint with letters and/or logo, mid-court letters and/or logo (2 sides) and center graphics with school logo and lettering. Architect will provide graphic design. Vendor to submit final proof for approval by Architect.

G. Wall Base
   1. 3" X 4", heavy duty, molded, vented cove base with pre-molded outside corners.

H. Thresholds
   1. Expansion two-part aluminum as manufactured by National Guard Products.

I. Equipment Sleeves
   1. Install sleeves and floor plates for volleyball. Refer to *Division 11 66 23* for equipment information.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect concrete slab for proper tolerance and dryness. Report any discrepancies to General Contractor and Architect in writing.

B. Concrete slab shall be broom cleaned by general contractor.

C. MFMA Mill Accredited Installation Company shall document all working conditions provided in General Specification prior to commencement of installation.

3.02 INSTALLATION

A. Subfloor
   1. Cover concrete with poly, sealing and lapping joints a minimum of 6".
   2. Layout subfloor assembly with sleepers at right angle to finish flooring. Place subfloor panels to maintain spacing between panel edges as provided between pre-assembled sleepers. Lap panel nailer ends onto designated cross struts, providing 1/4" end joint spacing, and secure with nails or staples and construction adhesive. Align subfloor panels to provide correct stagger of concrete anchors in adjacent rows. Provide 1-1/2" expansion voids at perimeter and at vertical obstructions. Install solid blocking at doorways, under bleachers in the stacked position, and below portable goals.
   3. Secure sleeper struts to concrete with steel anchors inserted into anchor pockets provided. Maintain proper anchor penetration with Connor installation tools and procedures.

B. Maple Flooring
   1. Install maple flooring parallel to main playing court by power nailing or stapling at all sleeper locations. End joints shall be properly driven up.
   2. If required, size joints between flooring strips to allow for intermediate expansion in accordance with local humidity conditions.
   3. Provided 1-1/2" expansion voids at perimeter and at all vertical obstructions.

3.03 FINISHING

A. Maple Flooring
   1. Machine sand with coarse, medium, and fine paper to a smooth, even and uniform surface.
   2. Remove sanding dust from entire surface by tack or vacuum.
   3. Inspect entire area of floor to ensure that surface is acceptable for finishing, clean and completely free from sanding dust.
   4. Apply two (2) coats of approved seal and two (2) coats of approved finish per manufacturer's instructions.
   5. Buff and clean floor between coats.
   6. Games Lines: Apply game lines as indicated on drawings, between seal and first coat of finish.

3.04 VOLLEYBALL SLEEVES INSTALLATION

A. Coordinate location of volleyball sleeves with General Contractor.
B. Install volleyball sleeves per manufacturer requirements.
C. Install volleyball covers per manufacturer requirements.

3.05 WALL BASE INSTALLATION

A. Install vent cove base to walls with base cement or screws. Use pre-molded outside corners and mitered inside corners.

3.06 CLEANING

A. Remove excess and waste materials from the area of work.

DIVISION 09 66 23 – EPOXY TERRAZZO

Designer shall provide an alternate design and layout for an epoxy terrazzo floor finish. Terrazzo shall be installed in all high traffic and communal areas such as hallways, corridors, foyers, main lobbies, multipurpose rooms, cafeterias, nurse' stations, etc.

Terrazzo shall be a thin-set epoxy terrazzo and comply with NTMA's written recommendations for terrazzo and accessory installation.
Transition strips shall be installed in doorways to spaces with different floor finishes that abut the terrazzo floor finish such as carpet, LVT, VCT, etc. Careful selection of thresholds shall be considered for future maintenance and replacement. Thresholds shall meet ADA criteria and eliminate any trip hazards.

Epoxy type terrazzo floors shall be burnished/ polished and not waxed to a high gloss finish comparable to a floor wax shine.

DIVISION 09 68 00 – CARPET TILE

PART 1 GENERAL

This section describes the requirements for carpet tiles to be installed in MSCS projects.
CARPET: Carpet shall be designed for medium to high traffic use. Recommendations include but are not limited to the following: Class III, tufted, commercial carpet, type 6 or 6.6 nylon with modification ratio of 2.2 or less, minimum pile weight: 24 oz./yd., non-woven polyester backing, 20-pound tuft bind, multi-level loop pile, permanent anti-static control, 100% solution dyed, tweed pattern and antimicrobial protection required. Carpet shall carry 15-year warranty. Carpet shall be CRI Green Label Plus or equal.
Carpet shall bear Green Label Plus or other acceptable certification to contribute to LEED certification, as required. Product testing and/or certification must be clearly specified in the construction documents.
Installation connectors shall be specified in lieu of glue (sprayed or spread). Carpet manufacturer's modular tile glue free installation system. All carpets and components shall be recyclable. Use carpet tile in rooms where electrical floor boxes exist.

BASIS OF DESIGN: Interface
EDGE STRIPS: When an edge strip is needed at a transition between carpet and tile flooring, it shall be specified as a metal edge strip or an approved equal.

1.01 SECTION INCLUDES

A. Carpet tile fully adhered.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.
B. *Division 09 05 61* - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

1.03 REFERENCE STANDARDS

A. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.
H. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional provisions.
    2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing carpet tile with minimum three years' documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tile Carpeting: Basis of design indicated on Drawings.

2.02 MATERIALS

A. Tile Carpeting, Type CPT-1: Tufted, textured loop, manufactured in one color dye lot.
B. Tile Carpeting, Type CPT-2: Tufted, textured loop, manufactured in one color dye lot.

2.03 ACCESSORIES

A. Edge Strips: As indicated on drawings, color as selected by Architect.
B. Adhesives:
    1. TacTiles™ adhesive dot installation system.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
    1. Test in accordance with Section 09 0561.
    2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
    3. Follow moisture and alkalinity remediation procedures in Section 09 0561.
D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prepare floor substrates for installation of flooring in accordance with Section 09 0561.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.
B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).
C. Blend carpet from different cartons to ensure minimal variation in color match.
D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
E. Lay carpet tile in indicated pattern, with pile direction parallel to next unit, set parallel to building lines.
F. Locate change of color or pattern between rooms under door centerline.
G. Fully adhere carpet tile to substrate.
H. Trim carpet tile neatly at walls and around interruptions.
I. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
B. Clean and vacuum carpet surfaces.

DIVISION 09 84 30 – SOUND-ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sound-absorbing panels.
B. Sound-absorbing ceiling baffles.
C. Mounting accessories.

1.02 RELATED REQUIREMENTS

A. *Division 09 51 00* - Acoustical Ceilings: Ceiling suspension system.
B. *Division 09 90 00* - Painting and Coating.

1.03 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.
B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
C. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2005 (Reapproved 2012).

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's printed data sheets for products specified.
C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
D. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch, showing construction, edge details, and fabric covering.
E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.
F. Manufacturer's Qualification Statement.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Extra Panels: Quantity equal to 5 percent of total installed, but not less than one of each type.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company with not less than five years of experience in manufacturing acoustical products similar to those specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
B. Store units flat, in dry, well-ventilated space; do not stand on end.
C. Protect edges from damage.

PART 2 PRODUCTS

2.01 FABRIC-COVERED SOUND-ABSORBING UNITS

A. Manufacturers:
   1. Basis of Design: Armstrong Ceilings: www. armstrongceilings.com/walls
   2. Essi Acoustical Products Company: www.essiacoustical.com/#sle.
   3. LAMVIN: www.lamvin.com/#sle.
   4. Owens Corning Conwed Designscape: www.conweddesignscape.com/#sle.
   5. TECHLITE: www.techlite.com/#sle.
   6. Approved Equal.
   7. Substitutions: See *Division 01 60 00* - Product Requirements.

B. General:
   1. Prefinished, factory assembled fabric-covered panels.
   2. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.

C. Fabric-Covered Acoustical Panels for Walls and Ceilings: Type AWP-1, AWP-2, AWP-3, AWP-4:
   1. Panel Core: Manufacturer's standard rigid or semi-rigid fiberglass core.
   2. Noise Reduction Coefficient (NRC): 80 when tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.
   3. Panel Size: As indicated in drawings.
   4. Panel Thickness: As required to meet required acoustical performance.
   5. Fabric: Woven polyester.
   6. Color: As indicated on drawings.
   7. Patterns: Where fabric with directional or repeating patterns or fabric with directional weave is used, mark for installation in same direction.
   8. Mounting Method: Spline-mounted, concealed.

D. Fabric-Covered Acoustical Ceiling Baffles: Type ACB-3:
   1. Baffle Core: Manufacturer's standard rigid or semi-rigid fiberglass core.
   2. Baffle Size: As indicated on drawings.
   3. Baffle Thickness: 2 inches.
   4. Color: As indicated on drawings.
   5. Patterns: Where fabric with directional or repeating patterns or fabric with directional weave is used, mark for installation in same direction.
   6. Mounting: Vertically suspended from ceiling or structure by one edge of panel.

2.02 FELT SOUND-ABSORBING UNITS

A. Manufacturers:
   1. Basis of Design: Turf Design: www.turf.design.
   2. Zintra: www.zintraacoustic.com.
   3. Arktura: www.arktura.com.
   4. Approved Equal.
   5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Sound Absorbing Units: PET felt board.
   1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.

C. Felt Acoustical Tile for Walls: Type AWT-1, AWT-2, 9mm PET felt board.
   1. Panel Size: As indicated on drawings.
   2. Mounting: Direct applied with adhesive.

D. Felt Ceiling Baffles: Type ACB-1, ACB-2, PET felt board.
   1. Shape: As indicated on drawings.
   2. Size: As indicated on drawings.
   3. Mounting: Vertically suspended from ceiling or structure from one edge of baffle.

2.03 FABRICATION

A. Fabric Wrapped, General: Fabricate panels to sizes and configurations as indicated, with fabric facing installed without sagging, wrinkles, blisters, or visible seams.
   1. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.

2. For panels suspended from ceiling, provide fabric covering both sides, with seams only at panel edges.

B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

C. Factory-applied finishes on wood veneer panels to be uniform, smooth, and without blemishes.

2.04 ACCESSORIES

A. Spline-Mounting Accessories: Manufacturer's standard concealed connecting splines of extruded aluminum designed for screw attachment to walls, with coordinating moldings and trim for interior and exterior corners and miscellaneous conditions.
1. Color of Exposed Trim: As selected from manufacturer's standards.

B. Ceiling-Suspended Accessories: Manufacturer's standard accessories at locations as indicated on each acoustical unit, sized appropriately for weight of acoustical unit.

C. Panel Adhesive: Acceptable to acoustical panel manufacturer for application as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.

B. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

C. Suspend ceiling baffles at locations and heights as indicated.

D. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
1. Plumb and level.
2. Flatness.
3. Width of joints.

3.03 CLEANING

A. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

A. Provide protection of installed acoustical panels until Date of Substantial Completion.

B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect/Engineer.

DIVISION 09 90 00 – PAINTING AND COATING

PART 1 GENERAL

SINGLE SOURCE RESPONSIBILITY: Provide finish paint and undercoat paint produced by the same manufacturer. If painting a previously painted surface, designer is responsible for specifying products that are compatible with the existing surfaces. A paint compatibility test is recommended.
SW Navajo White or equivalent is the preferred General Wall Paint Color. The color scheme will be approved by Director of DoMC during the design process. Colors will then be presented to the administration and school staff for review and comment only. The color schemes shall be completely defined in contract drawings. Limit number of paint colors.

PAINT: Apply low sheen paint such as satin to CMU walls. Use eggshell for gypsum wallboard walls. Provide finish in high traffic areas that can be washed and scrubbed easily. MSCS prefers **latex acrylic or water-borne epoxy** for the high traffic areas such as corridors, group toilets, locker rooms, cafeterias and multipurpose rooms. Corridors and high traffic areas are recommended to have a two-tone paint finish. DARK COLORS ARE DISCOURAGED unless necessary for the design intent and approved by the MSCS DoMC. If used, Designer shall adjust application methods to ensure that a complete, consistent, and uniform coverage is obtained. This may include but not be limited to additional primer and finish coats, application methods, surface preparations, etc.

DOOR FRAMES: Semi-gloss.

Specify water-based solvent and mercury free paint with low or zero VOCs.

BLOCK FILLER: Shall be applied to all exposed masonry block. Specify two coats of block filler in Kitchen and Dishwasher areas to completely fill block pores to eliminate pinholes in painted finish and shall be approved by the Owner before application of finish paint. Block filler equivalent or substitute will be considered on a case-by-case basis.

COLOR SCHEMES: The designer shall include a final color schedule in the project construction documents. The contractor shall provide a final paint schedule of all paint used on the project. This schedule shall have as a minimum the following information for each paint used: paint manufacturer name, paint color name, number and the area of the school where each paint was applied. The final paint schedule shall be included in the Operation and Maintenance Manuals.

CORRIDORS: Corridors shall be a two-tone color scheme with a darker color on the lower portion of the scheme. Height of darker color shall be 5'-4" above finished floor.

CABLING: The designer is to verify that any cabling called out to be painted is acceptable to code and the cable manufacturer.
Require a sample finish to be applied to the wall of the PM's choice for each color and type of finish wall or surface.

RESTROOMS/ AREAS SUBJECTED TO VANDALISM: In areas where there may be a high probability of vandalism such as graffiti, Designer shall include in the construction documents directives to use anti-graffiti protective coatings for long term easy cleaning and maintenance. Preferred manufacturers for basis of design include but are not limited to Sherwin Williams, Tex-Cote LLC, Vanguard, TK-PermaClean, or approved equal.

1.01 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.

1.02 RELATED REQUIREMENTS

A. *Division 01 61 16* - Volatile Organic Compound (VOC) Content Restrictions.

1.03 DEFINITIONS

A. Sheen Levels: ASTM D523.
   1. Flat: Five gloss units at 60 degrees and 10 gloss units at 85 degrees, maximum.
   2. Eggshell: 10 to 25 gloss units at 60 degrees and 10 to 35 gloss units at 85 degrees.
   3. Satin: 20 to 35 gloss units at 60 degrees and 35 gloss units minimum at 85 degrees.
   4. Semi-Gloss: 35 to 70 gloss units at 60 degrees.
   5. Gloss: 70 gloss units at 60 degrees, minimum.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting:
   1. Conduct meeting one week, minimum, before starting Work of this Section.

1.05 SUBMITTALS

A. See *Division 01 30 00* Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   3. Manufacturer's installation instructions.
C. Samples:
   1. Draw Down Samples: Each type of paint system and each topcoat color and gloss.
      a. Label each Sample for paint type, location, and substrate.
D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
E. Manufacturer's Instructions: Indicate special surface preparation procedures.
F. Maintenance Data:
   1. Cleaning, touch-up, and repair instructions for painted and coated surfaces.
   2. Area summary with finish schedule and color samples, designating where each product, color and finish was used.

G. Extra Stock Materials:
    1. Paint from same product run as installed materials.
        a. Quantity: 5 percent, but not less than 1 gallon of each material and color.

1.06 QUALITY ASSURANCE

A. Field Samples: Apply each paint systems to substrates as directed by Architect and 100 square feet minimum. Demonstrate texture and color.
    1. Approved samples establish work results standard.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
C. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience.

1.07 MOCKUPS

A. See *Division 01 40 00* - Quality Requirements for additional requirements.
B. See *Division 01 43 39* - Mockups for additional requirements.
C. Locate as indicated on drawings.
D. Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
    1. Architect will select one surface for application of each paint system specified.
        a. Vertical and horizontal surfaces: Provide samples of 100 sq. ft. minimum.
    2. Final approval of color selections will be based on mockups.
        a. If color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to the Owner.
    3. Approval of mockups does not constitute approval of deviations from the Contract Documents unless Architect specifically approves such deviations in writing.
    4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:
    1. Store paint products in sealed containers until ready for use.
B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Apply materials only when surface and ambient temperatures are within temperature ranges required by paint product manufacturer.
B. Apply exterior coatings when rain or snow are not occurring or forecasted, and when relative humidity is inside humidity ranges, and moisture content of surfaces is within acceptable levels required by paint product manufacturer.
C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Colors by Basis of Design Manufacturer Designations by Architect/Owner.
B. Manufacturers:
    1. BEHR.
    2. Benjamin Moore.
    3. PPG Paints.
    4. Sherwin-Williams.
    5. Approved Equal.
    6. Substitutions: See *Division 01 60 00* - Product Requirements.
C. Products: As indicated on drawings.

2.02 PAINT, GENERAL

A. Paint Systems: Primers, intermediate coats and topcoats compatible with substrates and one

another.

B. Coatings: Ready mixed or field-catalyzed.

C. Preparation:

1. Mix to soft paste consistency, capable of being readily and uniformly dispersed to homogenous coating.
2. Blend tints and catalyzers to uniform consistency and color, capable of drying or curing free of streaks or sags.

2.03 SOURCE QUALITY CONTROL

A. Tests:

1. Testing: Owner may engage a qualified testing agency to sample paint materials delivered to project site or taken from supplier's facility.
2. Acceptance Criteria: Products comply with specified requirements.

B. Non-Conforming Work: Remove materials from substrates, pay for testing of replacement products, and repaint surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify substrates are ready to receive work.

B. Preinstallation Testing: Test moisture content of substrate does not exceed the following:

1. Concrete: 12 percent.
2. Masonry: 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.

C. Gypsum Board: Verify that finishing compound is dried and sanded smooth.

D. Concrete and Masonry: Verify surface has cured at least 30 days and that the pH of the surface is between 6 and 9.

3.02 PREPARATION

A. Surface Preparation: Remove and Mask electrical plates, hardware, trim, escutcheons, and fittings. Correct defects in substrates capable of affecting work.

B. Cleaning: Remove substances that could impair paint bond, including dust, oil, grease, and incompatible coatings.

1. Impervious Surfaces: Remove mildew by scrubbing with cleaning solution recommended by finish coating manufacturer. Rinse with clean water and allow surface to dry.
2. Aluminum Surfaces: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
3. Asphalt, Creosote, or Bituminous Surfaces: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.
4. Concrete Floors: Follow manufacturer recommendations.
5. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
6. Plaster Surfaces: Fill cracks, holes, and other imperfections with latex patching plaster. Blend texture with adjacent surfaces. Clean and allow to dry.
7. Concrete and CMU Surfaces: Remove dirt, loose mortar, scale, efflorescence and chalk. Remove oil and grease by scrubbing with cleaning solution recommended by finish coating manufacturer. Rinse with clean water and allow surface to dry.
8. Non-Passivated Galvanized Surfaces: Smooth and hand or power tool clean per ASTM D6386.
9. Passivated Galvanized Surfaces: Remove soluble and insoluble contaminants and corrosion. Sweep blast per ASTM D6386 to achieve uniform 1.0 to 2.0 mil anchor profile.
10. Uncoated Steel: Remove rust and loose mill scale. Clean per SSPC-SP 6/NACE No. 3 "Commercial Blast Cleaning.
11. Primed Steel: Clean field welds, fasteners, and abraded shop primer.
12. Wood Surfaces:
    a. Wipe off dust and grit. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried.
    b. Backprime concealed surfaces.

3.03 APPLICATION

A. Follow manufacturer instructions for application method, thickness of coatings, and number of coats.
   1. Apply finishes when surfaces are dry. Allow applied coats to dry before next coat is applied.
   2. Apply each coat of paint slightly darker than preceding coat.
   3. Apply coatings to uniform appearance.
   4. Sand wood and metal surfaces lightly between coats.
   5. Leave testing agency, equipment identification, and performance labels unpainted.

B. Appearance:
   1. Apply paints without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, or other imperfections.
   2. Edges and Color Breaks: Produce sharp edges.

3.04 PAINTING MECHANICAL EQUIPMENT

A. Paint the following equipment when exposed in equipment rooms, occupied spaces, and exterior areas:
   1. Electrical panelboards and switchgear.
   2. Piping.
   3. Ductwork. (cafeteria, gym interior and exterior, similar location exposed to view)
   4. Pipe hangers.
   5. Conduit.
   6. Unfinished tanks.
   7. Shop-primed equipment.

B. Paint interior surfaces of air ducts visible through grilles with one coat of flat black paint.

3.05 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to work areas.
   1. Failed Test Retest Cost: Contractor responsibility.

B. Testing: Dry film thickness.

C. Non-Conforming Work: Remove and replace or apply additional coats, and re-test.

3.06 CLEANING

A. Cleaning:
   1. Remove rubbish, empty cans, rags, and other discarded materials.
   2. Remove splattered paints. Protect adjacent surfaces from damage.

3.07 PROTECTION

A. Protection: Protect painted surfaces from subsequent construction work. Touch up and restore damaged painted surfaces.

3.08 INTERIOR PAINTING SCHEDULE

A. Concrete Walls and Ceilings - Dry Environments:
   1. Latex primer:
      a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
      b. Benjamin Moore: Ultra Spec Masonry 100% Acrylic Sealer 608.
      c. PPG Paints: Perma-Crete Interior/Exterior Alkali Resistant Primer 4-603XI.
      d. Sherwin-Williams: Loxon Concrete & Masonry Primer, LX02 Series.
   2. Acrylic-Latex Enamel: Eggshell finish.
      a. BEHR: Behr Pro i300 Interior.
      b. Benjamin Moore; Ultra Spec 500 Series.
      c. PPG Paints: SPEEDHIDE Zero Interior Latex.
      d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex.

B. CMU Substrates - Dry Environments:
   1. Block Filler:
      a. BEHR: Behr Pro Block Filler Primer, PR50.
      b. Benjamin Moore: Ultra Spec Masonry Hi-Build Block Filler 571.
      c. PPG Paints: 6-7 Speedhide Latex Block Filler.
      d. Sherwin-Williams: PrepRite Latex Block Filler, B25W25.
   2. Acrylic Latex Enamel: Eggshell finish.
      a. BEHR: Behr Pro i300 Interior.

b. Benjamin Moore: Ultra Spec 500 Series.
c. PPG Paints: SPEEDHIDE Zero Interior Latex.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex.

C. CMU Substrates - Wet Environments:
1. Block Filler:
a. BEHR: Behr Pro Block Filler Primer, PR50.
b. Benjamin Moore: Corotech Waterborne Epoxy Block Filler 163
c. PPG Paints: Amerlock 400 BF or Perma-Crete Concrete Block & Masonry Surfacer/Filler.
d. Sherwin-Williams: Pro Industrial Heavy Duty Block Filler B42W00150 or Kem Cati-Coat HS Epoxy Filler/Sealer B42W400 Series.
2. Epoxy Topcoats: Eggshell finish.
a. BEHR: US Coatings EpoxyGrip 2000 VOC Epoxy Mastic Coating.
b. Benjamin Moore: Corotech Surface Tolerant Epoxy Mastic V160.
c. PPG Paints: Amerlock 2/400.
d. Sherwin-Williams: Macropoxy 646.

D. Gypsum Board Walls:
1. Latex Primer:
a. BEHR: Drywall Plus Interior Primer & Sealer 73.
b. Benjamin Moore: Ultra Spec 500 Interior Latex Primer N534.
c. PPG Paints: SPEEDHIDE zero Interior Latex Sealer 6-4900XI.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex Primer B28W02600.
2. Acrylic-Latex Enamel (Dry Environments): Eggshell finish.
a. BEHR: Behr Pro i300 Interior.
b. Benjamin Moore: Ultra Spec 500 Series.
c. PPG Paints: SPEEDHIDE Zero Interior Latex.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex.
3. Epoxy Topcoat (Wet Environments): Eggshell finish.
a. BEHR: Behr Pro Pre-Catalyzed Waterborne Epoxy.
b. Benjamin Moore: Corotech Pre Catalyzed Epoxy.
c. PPG Paints; PITT-GLAZE WB1 Interior Pre-Catalyzed Water-Borne Acrylic Epoxy.
d. Sherwin-Williams: Pro Industrial Pre-Catalyzed Water Based Epoxy.

E. Gypsum Board Ceilings:
1. Latex Primer.
a. BEHR: Drywall Plus Interior Primer & Sealer 73.
b. Benjamin Moore: Ultra Spec 500 Interior Latex Primer N534.
c. PPG Paints: SPEEDHIDE zero Interior Latex Sealer 6-4900XI.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex Primer B28W02600.
2. Acrylic Latex Enamel: Flat finish.
a. BEHR: Behr Pro i300 Interior.
b. Benjamin Moore: Ultra Spec 500 Series.
c. PPG Paints: SPEEDHIDE Zero Interior Latex.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex.

F. Steel Doors and Frames:
1. Pre-Primed Metal: Touch up with same shop primer product used by manufacturer.
2. Latex Primer.
a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
b. Benjamin Moore: Ultra Spec HP Acrylic Metal Primer HP04.
c. PPG Paints: Pitt-Tech Plus DTM 4020PF.
d. Sherwin-Williams: Pro Industrial Pro-Cryl Universal Primer B66-1310 Series.
3. Epoxy Topcoat: Semi-gloss finish.
a. BEHR: Behr Pro Pre-Catalyzed Waterborne Epoxy.
b. Benjamin Moore: Corotech Pre Catalyzed Epoxy.
c. PPG Paints; PITT-GLAZE WB1 Interior Pre-Catalyzed Water-Borne Acrylic Epoxy.
d. Sherwin-Williams: Pro Industrial Pre-Catalyzed Water Based Epoxy.

G. Steel Railings:
    1. Pre-Primed Metal: Touch up with same shop primer product used by manufacturer.
    2. Latex Primer:
        a. BEHR: Interior/Exterior Metal Primer, 435.
        b. Benjamin Moore: Ultra Spec HP Acrylic Metal Primer HP04.
        c. PPG Paints: Pitt-Tech Plus DTM 4020PF.
        d. Sherwin-Williams: Pro Industrial Pro-Cryl Universal Primer B66-1310 Series.
    3. Epoxy Topcoat: Semi-gloss finish.
        a. BEHR: Behr Pro Pre-Catalyzed Waterborne Epoxy.
        b. Benjamin Moore: Corotech Pre Catalyzed Epoxy.
        c. PPG Paints; PITT-GLAZE WB1 Interior Pre-Catalyzed Water-Borne Acrylic Epoxy.
        d. Sherwin-Williams: Pro Industrial Pre-Catalyzed Water Based Epoxy.

H. Galvanized Steel Substrates:
    1. Latex Primer.
        a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
        b. Benjamin Moore: Ultra Spec HP Acrylic Metal Primer HP04.
        c. PPG Paints: Pitt-Tech Plus DTM 4020PF.
        d. Sherwin-Williams: Pro Industrial Pro-Cryl Universal Primer B66-1310 Series.
    2. Acrylic Latex Enamel: Semi-gloss finish.
        a. BEHR: PREMIUM Interior/Exterior Direct to Metal Paint.
        b. Benjamin Moore: Ultra Spec HP D.T.M Acrylic Enamel.
        c. PPG Paints: Pitt-Tech Plus Interior/Exterior DTM Industrial Enamel 4216 SG or 90 Series
        d. Sherwin-Williams: Pro Industrial Acrylic.

I. Overhead Exposed Construction:
    1. Water Based Interior Dry Fog: Flat finish.
        a. BEHR: Pro HPC Waterborne Dryfall HP210.
        b. Benjamin Moore: Latex Dry Fall.
        c. PPG Paints: Speedhide SuperTech Interior Latex Dry-Fog.
        d. Sherwin-Williams: Pro Industrial Waterborne Acrylic Dryfall.

J. Wood Trim:
    1. Latex Primer:
        a. BEHR: Drywall Plus Interior Primer & Sealer 73.
        b. Benjamin Moore: Advance Waterborne Interior Alkyd Primer 790.
        c. PPG Paints: Seal-Grip Interior/Exterior Universal Primer/Sealer 17-921XI.
        d. Sherwin-Williams: PrepRite ProBlock Interior/Exterior Latex Primer/Sealer B51-600.
    2. Acrylic-Latex Enamel: Eggshell finish.
        a. BEHR: Behr Pro i300 Interior.
        b. Benjamin Moore: Ultra Spec 500 Series.
        c. PPG Paints: SPEEDHIDE Zero Interior Latex.
        d. Sherwin-Williams: ProMar 400 Zero VOC Interior Latex.

3.09 EXTERIOR PAINTING SCHEDULE

A. Concrete Nontraffic Surfaces:
    1. Primer:
        a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
        b. Benjamin Moore: Ultra Spec Int/Ext Masonry sealer (608).
        c. PPG Paints: PERMA-CRETE Interior/Exterior Alkali Resistant Primer.
        d. Sherwin-Williams: Loxon Concrete and Masonry Primer/Sealer LX02.
    2. Exterior Acrylic Latex Topcoat: Eggshell finish.
        a. BEHR: PRO e600 Exterior Paint.
        b. Benjamin Moore: Ultra Spec Exterior Enamel.
        c. PPG Paints: SPEEDHIDE Exterior Latex
        d. Sherwin-Williams: Pro Industrial Acrylic B66-600 Series.

B. CMU Substrates:
    1. Latex Block Filler:
        a. BEHR: Behr Pro Block Filler Primer, PR50.

b. Benjamin Moore: Ultra Spec Masonry Hi-Build Block Filler 571.
c. PPG Paints; Perma-Crete Concrete Block & Masonry Surfacer/Filler.
d. Sherwin-Williams: Conflex XL Block Filler, CF01W50.

2. Exterior Latex Topcoat: Eggshell finish.
   a. BEHR: PRO e600 Exterior Paint.
   b. Benjamin Moore: Ultra Spec Exterior Enamel.
   c. PPG Paints: SPEEDHIDE Exterior Latex
   d. Sherwin-Williams: A100 Series Exterior Latex.

C. Unprimed Ferrous Metal:
1. Rust-Inhibitive Alkyd Primer:
   a. BEHR: Interior/Exterior Metal Primer 435.
   b. Benjamin Moore: Super Spec HP Alkyd Metal Primer P06.
   c. PPG Paints: Devguard 4360.
   d. Sherwin-Williams: Kem Bond HS, B50 Series
2. Latex Topcoat: Semi-gloss finish.
   a. BEHR: PREMIUM Direct to Metal Semi-Gloss Paint 3200.
   b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
   c. PPG Paints: Pitt-Tech Plus Interior/Exterior DTM Industrial Enamel 4216 Series
   d. Sherwin-Williams: Pro Industrial Acrylic B66-600 Series.

D. Galvanized Steel:
1. Primer:
   a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
   b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
   c. PPG Paints: Pitt-Tech Plus DTM Primer 4020PF.
   d. Sherwin-Williams: Pro Industrial ProCryl Universal Primer B66-1300 Series.
2. Latex Topcoat: Semi-gloss finish.
   a. BEHR: PREMIUM Direct to Metal Semi-Gloss Paint 3200.
   b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
   c. PPG Paints: Pitt-Tech Plus Interior/Exterior DTM Industrial Enamel 4216 Series
   d. Sherwin-Williams: Pro Industrial Acrylic B66-600 Series.

E. Aluminum:
1. Primer:
   a. BEHR: PREMIUM PLUS Exterior Multi-Surface Primer & Sealer 436.
   b. Benjamin Moore: Corotech Waterborne Bonding Primer (V175).
   c. PPG Paints: Pitt-Tech Plus 4020PF.
   d. Sherwin-Williams: Pro Industrial ProCryl Universal Primer B66-1310 Series.
2. Latex Topcoat: Semi-gloss finish.
   a. BEHR: Interior/Exterior Direct To Metal Semi-Gloss Paint 3200.
   b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
   c. PPG Paints: Pitt-Tech Plus Interior/Exterior DTM Industrial Enamel 4216 Series
   d. Sherwin-Williams: Pro Industrial Acrylic B66-600 Series.

DIVISION 10 11 00 – VISUAL DISPLAY UNITS (MARKER BOARDS & TACKBOARDS)

PART 1 GENERAL

Provide Marker boards and tack boards in accordance with the building program for each specific project. Attention to the constraints of applicable codes governing the use of combustible materials is required. Do not specify combination marker/tack board units.

DRY-ERASE MARKER BOARDS: 24-gauge porcelain enamel steel face with backer board in extruded aluminum frame. Provide head tack strip where specified by program. Provide marker tray on all marker boards except for in Playrooms, locker rooms, or other areas of high student activity. Finish shall be manufacturer's standard low- gloss white.

TACKBOARDS: 1/4" thick composition cork mounted to 1/4" hardboard in extruded aluminum frame. Fabricate composition corkboard of pure cork material compounded with linseed oil and pigment on burlap back. Use Forbo Linoleum, Inc. bulletin board as a basis of design. Provide head tack strip where specified by program.

HEAD TACK STRIPS: Shall be 1/4" thick composition cork mounted to 1/4" hardboard in extruded aluminum frame. Where specified by program, tack strip to be 12” high and shall extend full width of adjacent marker and tack boards.
Consider running two 2” wide tack strips down some corridors to aid in displaying current student work. Tack strips shall be located at 5’-4” above finished floor and 3’-4” above finished floor.

ACCESSORIES: Furnish standard continuous box-type aluminum marker tray with slanted front, rounded edges and cast aluminum end closures for each marker board. Furnish map rail complete with 1"-2" wide cork display rail, end stops, one flag holder per room and 2 map hooks for each 4 feet of rail. Map rail shall extend full width of adjacent marker boards and tack boards. All products shall have a 50-year warranty.
All dry-erase marker boards, tack boards, and tack strips shall be factory assembled.
Size, location and mounting height of marker boards, tack boards, and tack strips shall be according to building program requirements.

At physical activity spaces such as dance studios, gyms, and multi-purpose rooms, do not provide protruding trays at marker board installations.

1.01 SECTION INCLUDES

A. Markerboards.

1.02 RELATED REQUIREMENTS

A. *Division 09 21 16* - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.03 REFERENCE STANDARDS

A. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
B. ANSI A208.1 - American National Standard for Particleboard; 2009.
C. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.
D. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.
E. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
F. PS 1 - Structural Plywood; 2009.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's data on markerboard, trim and accessories.
C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
D. Samples: Color charts for selection of color and texture of markerboard, trim.
E. Test Reports: Show compliance to specified surface burning characteristics requirements.
F. Manufacturer's printed installation instructions.
G. Manufacturer's Qualification Statement.
H. Maintenance Data: Include data on regular cleaning and stain removal .

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.
B. Provide Lifetime warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Visual Display Units:
   1. Basis of Design: Claridge Products and Equipment, Inc: www.claridgeproducts.com.
   2. Polyvision Corporation (Nelson Adams): www.polyvision.com.
   3. Approved Equal.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 VISUAL DISPLAY UNITS

A. Porcelain Enamel Steel Markerboards:
   1. Color: Low-gloss white.
   2. Steel Face Sheet Thickness: 24-gauge, 0.0239 inch.
   3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.

4. Backing: Aluminum foil, laminated to core.
5. Size: As indicated on drawings.
6. Frame: Extruded aluminum, with concealed fasteners.
7. Frame Finish: Anodized, natural.
8. Accessories: Provide marker tray and map rail. No marker tray on markerboards located in locker rooms.

2.03 MATERIALS

A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
B. Plywood: PS 1 Grade C-D, softwood.
C. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).
D. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
E. Gypsum Board: ASTM C1396/C1396M, paper/foil faced, plain type.
F. Fiber Board: ASTM C208, cellulosic fiber board.
G. Foil Backing: Aluminum foil sheet, 0.005 inch thick.
H. Aluminum Sheet Backing: 27-gauge, 0.014 inch thick.
I. Steel Sheet Backing: 28-gauge, 0.0149 inch, galvanized.
J. Adhesives: Type used by manufacturer.

2.04 ACCESSORIES

A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1-inch wide overall, full width of frame.
B. Map Supports: Formed aluminum sliding hooks and roller brackets to fit map rail.
C. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.
D. Flag Holders: Cast aluminum bored to receive 1 inch diameter flag staff, bracketed to fit top rail of board.
E. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near chalkrail.
F. Marker Tray: Aluminum, manufacturer's standard profile, one-piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.
G. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that internal wall blocking is ready to receive work, and positioning dimensions are as indicated on shop drawings.
C. Verify flat wall surface for frameless adhesive-applied boards.

3.02 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.
B. Install above finished floor as indicated on drawings.
C. Secure units level and plumb.
D. Butt Joints: Install with tight hairline joints.

3.03 CLEANING

A. Clean board surfaces in accordance with manufacturer's instructions.
B. Cover with protective cover, taped to frame.
C. Remove temporary protective cover at Date of Substantial Completion.

DIVISION 10 14 00 – IDENTIFYING DEVICES AND SIGNAGES

PART 1 GENERAL

An exterior marquee sign will be required at the main site entrance of new schools. The school's name and street number shall be installed on the building exterior wall in a highly visible location using large aluminum letters to comply with local Codes and ordinances. Marquee sign installation shall include required underground electrical utilities and accessories for wireless. The marquee signage may require local authority approval for permitting.

Interior signs will be required at all doors to occupied spaces and as required by code. Interior signs shall be installed at heights and locations that comply with ADA criteria. Final room names and numbers will be

developed by the Architect and MSCS PM during design development. The room numbers on all drawings shall match the room number of the existing space in existing buildings. Provide a sign which meets the local ordinances. If additional information is required, it shall be provided by the MSCS PM.

INTERIOR SIGNS: Shall be manufactured from 1/16" clear matte acrylic that is sub-surface printed with a background color and laminated to a 1/16" opaque white or black acrylic base and has 1/16" raised acrylic letters. No abbreviations shall be permitted at elementary schools. Abbreviations are strongly discouraged at middle and high schools. Only signs for Library, Gymnasium, Cafeteria, Kitchen, Restrooms, Auditorium, Main Office and Mechanical/Electrical rooms shall have the room name permanently included on them. All other signs shall have the room number only. Classrooms and offices will have a slot for the insertion of a paper identifier which can be easily prepared and inserted by the Occupant of the space. All signage shall comply with current ADA requirements.

BRONZE OR ALUMINUM BUILDING DEDICATION PLAQUE: Information to be provided by MSCS PM and included on the plaque:

- Month and year opened
- Name of the School
- Names of the Shelby County Board of Education members at the time of project inception and/or completion. Designer to confirm and obtain MSCS approval.
- Name of Memphis-Shelby County Schools Acting Superintendent
- Name of Architectural Firm
- Name of General Contractor

**Include in Specification- "All Dedication Plaques shall be approved by the Director of Major Construction for recommendations to the executive administration for approval prior to order or installation. This includes but is not limited to size of the plaque, color of the sign, lettering style, content and order of content on sign.*

Replacement costs for Plaques without formal approval will be the responsibility of the Contractor.

1.01 SECTION INCLUDES

A. Room and door signs.
B. Dimensional letter signs.
C. School logo signs.
D. Vinyl Graphics.
E. Emergency evacuation maps.
F. Emergency shelter signs.
G. Building identification signs.
H. Plaque.
I. Traffic signs.

1.02 RELATED REQUIREMENTS

A. *Division 22 05 53* - Identification for Plumbing Piping and Equipment.
B. *Division 26 05 53* - Identification for Electrical Systems.
C. *Division 26 51 00* - Interior Lighting: Exit signs required by code.

1.03 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
D. ASTM E2072 - Standard Specification for Photoluminescent (Phosphorescent) Safety Markings; 2014.
E. UL 1994 - Luminous Egress Path Marking Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
C. Signage Schedule: Provide sufficient information to completely define each sign for fabrication, including scheduled and proposed room numbers, room names, other text to be applied, sign and letter sizes, fonts, and colors.

1. At Owner's discretion, room numbers on signs may differ from those on drawings. Submittal schedule shall, include the “per drawings” room names and numbers and space for “final” room names and numbers on schedule.
2. When content of signs is indicated to be determined later, request such information from Owner through Architect/Engineer at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
3. Submit for approval by Owner through Architect/Engineer prior to fabrication.

D. Samples: Submit two samples of each type of sign and of size similar to that required for project, illustrating sign style, font, and method of attachment.
E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
F. Verification Samples: Submit samples showing colors specified.
G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See *Division 01 60 00* - Product Requirements, for additional provisions.
2. Curved Sign Media Suction Cups: One for each 100 signs; for removing media.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
B. Subcontractor Qualifications:
1. Contract with or employ a subcontractor or company which specializes in the work herein specified.
2. Contract with or employ a subcontractor or company which has:
a. Five (5) years continuous and successful experience fabricating and installing cast aluminum products and materials, if these products are specified.
b. Completed ten (10) projects of similar size and scope.
c. An adequate number of skilled workmen who are trained and experienced in the necessary crafts and methods needed for a proper performance of the work.
d. Adequate and capable supervision and can ensure that all workmen are familiar with the requirements herein specified and are familiar with the requirements of the manufacturer whose materials or products will be installed in the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store materials in a locked, weathertight area. Remove from the locked area only those items to be immediately installed. Other items shall remain in locked storage until installation of same.
B. Package signs as required to prevent damage before installation.
C. Package room and door signs in sequential order of installation, labeled by floor or building.
D. Store tape adhesive at normal room temperature.

1.07 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flat Signs:
1. Best Sign Systems, Inc: www.bestsigns.com.
2. Cosco Industries (ADA signs): www.coscoarchitecturalsigns.com.
3. Cosco Industries (non-ADA signs): www.coscoarchitecturalsigns.com.
4. Inpro: www.inprocorp.com/#sle.
5. Mohawk Sign Systems, Inc: www.mohawksign.com.
6. Seton Identification Products: www.seton.com/aec.
7. ARK Ramos Inc.: www.arkramos.com.
8. Gemini, Inc.: www.signletters.com
9. Approved Equal.
10. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Dimensional Letter Signs:
1. Cosco Industries: www.coscoarchitec turalsigns.com.

2. Inpro: www.inprocorp.com/#sle.
3. Metal Arts, Inc.: www.metalarts.net.
4. ARK Ramos, Inc.: www.arkramos.com.
5. Gemini Inc.: www.signletters.com.
6. Approved Equal.
7. Substitutions: See *Division 01 60 00* - Product Requirements.

C. Plaques:
1. Cosco Industries: www.coscoarchitecturalsigns.com.
2. Metal Arts, Inc.: www.metalarts.net.
3. ARK Ramos, Inc.: www.arkramos.com.
4. Gemini Inc.: www.signletters.com.
5. Approved Equal.
6. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
1. Sign Type: Flat signs with engraved panel media as specified.
2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
3. Character Height: 1-3/4 inch.
4. Sign Height: 8 inches, unless otherwise indicated.
5. Classrooms and Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

C. Decorative Signs:
1. Sign Type: As indicated on the drawings.
2. Sizes: As indicated on drawings.
3. Wording of signs is to be determined by the Owner.

D. Emergency Evacuation Maps:
1. Allow for one map per elevator lobby.
2. Map content to be provided by Owner.
3. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.

E. Recognition Displays: Dimensional letters with individual recognition plaques.
1. Dimensions and Number of Name Signs: As indicated on drawings.
2. Design to be coordinated with signage vendor, owner, and alumni group.

F. Building Identification Signs:
1. Use individual metal letters.
2. Mount on outside wall in location indicated on drawings.
a. Type A: 14” high extruded aluminum back lit letters on stud with spacer for standoff from wall. Font to be Franklin Gothic Demi. Color TBD by architect.

G. Other Dimensional Letter Signs: Wall-mounted.
1. Exterior: Allow for total of 50 letters, 6 inches high, metal.
2. Interior: As indicated on drawings, exact wording to be determined. Height as indicated on drawings.

H. Plaque: See Allowance for details.
1. All Dedication Plaques shall be approved by the Director of Major Construction for

recommendations to the executive administration for approval prior to order or installation. This includes but is not limited to size of the plaque, color of the sign, lettering style, content and order of content on sign. Replacement costs for Plaques without formal approval will be the responsibility of the Contractor.

I. Traffic Signs: To match campus standards; locate where indicated on drawings.

2.03 SIGN TYPES

A. Flat Signs: Signage media without frame.
   1. Shall be manufactured from 1/16" clear matte acrylic that is sub-surface printed with a background color and laminated to a 1/16" opaque white or black acrylic base and has 1/16" raised acrylic letters. Only signs for Library, Gymnasium, Cafeteria, Kitchen, Restrooms, Auditorium, Main Office and Mechanical/Electrical rooms shall have the room name permanently included on them. All other signs shall have the room number only. Classrooms and offices will have a slot for the insertion of a paper identifier which can be easily prepared and inserted by the Occupant of the space. All signage shall comply with current ADA requirements.
   2. Edges: Square.
   3. Corners: Square.
   4. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
   5. Wall Mounting of One-Sided Signs: Tape adhesive.

B. Color and Font: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.

2.04 PLAQUES

A. Metal Plaques:
   1. Metal: Aluminum casting.
   2. Metal Thickness: 1/8-inch, minimum.

2.05 DIMENSIONAL LETTERS

A. Metal Letters:
   1. Metal: Aluminum casting.
   2. Finish: Brushed, satin.
   3. Color: TBD.
   4. Mounting: Pin Mounted.

B. Channell Letters:
   1. Material: 2” Return reverse letters.
   2. Color: TBD.

2.06 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
B. Exposed Screws: Chrome plated.
C. Tape Adhesive: Double sided tape, permanent adhesive.
D. Tape Adhesive: Double sided black adhesive sheet, permanent adhesive, use on signs mounted to glass.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install neatly, with horizontal edges level.
C. Protect from damage until Date of Substantial Completion; repair or replace damaged items.
D. Leave all signage clean, free from dirt, and imperfections. Any signage damaged prior to Owner occupancy will be replaced at no expense to Owners.
E. Verify masonry wall is ready for installation. Install with "hidden anchors."

DIVISION 10 21 00 – PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

TOILET PARTITIONS: Shall be floor mounted, overhead braced, solid color phenolic partitions at all student and group toilet installations. Doors shall be hung on a continuous stainless steel or aluminum hinge. Doors shall match partition construction. Colors shall be selected for each project from full range of available colors.

HARDWARE AND FITTINGS: Shall be heavy-duty stainless-steel construction with bright finish. Door hinges shall be self-closing continuous hinge with 20 degrees hold open. Continuous wall brackets shall be used at all toilets. Use "thru-bolts" (threaded insert with vandal resistant bolt at both sides) to secure hinges, brackets, stops and latches to doors and partitions. Provide vinyl bumper strips to absorb impact at doorstops and latch.

PARTITION DOORS: Shall be provided at all compartments and include door pulls. Where accessible stall doors swing towards a wall, place a bumper on the wall to protect the door edge and wall.
URINAL SCREENS: Shall be provided between adjacent urinals and where located next to lavatories. These screens shall be of the same construction as the toilet partitions.

1.01 SECTION INCLUDES

A. Phenolic toilet compartments.
B. Urinal screens.

1.02 RELATED REQUIREMENTS

A. *Division 05 12 00* - Structural Steel Framing: Concealed steel support members.
B. *Division 05 50 00* - Metal Fabrications: Concealed steel support members.
C. *Division 06 10 00* - Rough Carpentry: Blocking and supports.
D. *Division 10 28 00* - Toilet, Bath, and Laundry Accessories.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on panel construction, hardware, and accessories.
C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
D. Samples: Submit two samples of partition panels illustrating panel finish, color, and sheen, based on color selection on drawings.
E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 PHENOLIC TOILET COMPARTMENTS

A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid phenolic core panels with integral melamine finish, floor-mounted headrail-braced.
   1. Color: As indicated on drawings.
B. Screens: Without doors; to match compartments; mounted to wall with two panel brackets with vertical support/bracing same as compartments.

2.02 ACCESSORIES

A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
B. Head Rails: Hollow anodized aluminum, 1 inch by 1-1/2 inch size, with anti-grip profile and cast socket wall brackets.
C. Wall and Pilaster Brackets: Polished stainless steel; manufacturer's standard type for conditions indicated on drawings.
D. Attachments, Screws, and Bolts: Stainless-steel, tamper-proof type.

1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.

E. Hardware: Polished stainless steel:
   1. Hinges shall be self-closing continuous hinge with 20 degrees hold open.
   2. Nylon bearings.
   3. Door Latch: Slide type with exterior emergency access feature.
   4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
   5. Coat hook with rubber bumper; one per compartment, mounted on door.
   6. Provide door pull for out swinging doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify correct spacing of and between plumbing fixtures.
C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
B. Maintain 3/8 inch to 1/2-inch space between wall and panels and between wall and end pilasters.
C. Attach panel brackets securely to walls using anchor devices.
D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.
F. No evidence of drilling, cutting or patching shall be visible in the finished work.
G. Clearance at vertical edges of doors shall be uniform top to bottom and shall not exceed 3/16".
H. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
I. Wall-hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.
B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
C. Adjust adjacent components for consistency of line or plane.

3.05 CLEANING AND PROTECTION

A. Clean exposed surfaces of partition systems using materials and methods recommended by manufacturers and provide protection necessary to prevent damage during remainder of construction period.
B. Clean up all debris caused by the work of this section, keeping the premises clean and neat at all times.

DIVISION 10 22 26 – OPERABLE PARTITIONS

Operable partitions shall only be used with the express approval of the Director of Major Construction.
PARTITIONS: Shall be manually operated type, 20 lb. maximum pull, where size permits.
SOUND SEAL: shall be provided, with an STC rating of 54.

PANELS: shall be single panels only. The use of paired panels is NOT acceptable.
FINISH: MSCS prefers vinyl coating on lower half and fabric/ carpet covering on upper portion for sound attenuation qualities. Vinyl coating shall be no less than 18 oz.

MSCS prefers steel ball bearing wheels for easy operation and maintenance.

WARRANTY: Minimum 5-year warranty and 10-year special warranty for track trolley and panel.

Designers to coordinate required overhead structure to ensure support beam flanges compatible with manufacturer's support brackets.
Avoid the use of sound insulation or coverings that emit VOC's or use formaldehydes in the manufacturing process.

For operable partitions, only premium product lines of manufacturers will be accepted, provided they comply with requirements of the contract documents and have a low VOC. Insulate space above ceiling to deck above operable partition.

DIVISION 10 28 00 – TOILET, BATH AND LAUNDRY ACCESSORIES

PART 1 GENERAL

TOILET ACCESSORIES will be surface mounted type unless noted otherwise. Some accessories will be supplied by the Owner to the Contractor for installation. The designer shall check the dimensions of those items being provided and allow the proper space in all mounting locations. Designer to include mounting height elevations in construction documents to cover all age group users of the school. All mounting heights and clearances shall be in compliance with ADA criteria.

PAPER TOWEL DISPENSERS: Shall be supplied by the Owner and installed by the Contractor. Install one dispenser for every two lavatories for group toilets and one per sink in other areas; locate immediately adjacent to lavatories for ease of use.

SOAP DISPENSERS: Shall be supplied by the Owner and installed by the Contractor. Locate directly over lavatories and at required ADA heights.

TOILET PAPER HOLDERS: Designer to obtain cut sheet from MSCS DFM PM for standard roll dispenser. For toilets and stalls shall be supplied by the Owner and installed by the Contractor. The designer shall determine a solution for providing toilet paper holders that meet the requirements of the ADA for mounting height. Toilet paper holder types shall be selected so as not to conflict with grab bar locations.

WASTE RECEPTACLE: Shall be free standing waste basket provided by the Owner.

MIRRORS: Shall be polished stainless steel at student toilet rooms and framed mirror glass elsewhere. Size of mirrors at student toilet rooms to be approximately 18"w x 24"h at elementary student toilet rooms and 18"w x 30"h elsewhere. Mirrors shall be located on walls away from student lavatories. Mirrors at staff toilets may be located over lavatories. Assure that mirror heights meet ADA requirements for the reflective surface.

COAT HOOK: Shall be stainless steel with #4 satin finish and concealed attachment. Shall be provided at individual toilet rooms, individual offices and at door of all toilet partition compartments.
SANITARY NAPKIN DISPOSAL: Shall be of stainless-steel construction with #4 satin finish. Provide type for mounting onto toilet partitions. Recessed wall mounting shall not be specified. Shall be provided at all women's staff and girls' middle and high school toilet rooms. Install at each compartment of Group toilets rooms.

HAND DRYERS: If hand dryers are specified, a hard, cleanable surface shall be applied to the wall directly below the dryer to act as a splash guard. Materials approved to be used are stainless steel or solid surface.

1.01 SECTION INCLUDES

A. Commercial toilet accessories.
B. Description: The work under this section includes materials and installation of the toilet and bath accessories as indicated on the drawings and specified herein.
C. Diaper changing stations.
D. Utility room accessories.

1.02 RELATED REQUIREMENTS

A. *Division 06 10 00* - Rough Carpentry: Concealed supports for accessories, including in wall framing and plates and above ceiling framing.

B. *Division 04 20 00* - Unit Masonry: Unit masonry mounting.
C. *Division 09 21 16* - Gypsum Board Assemblies.
D. *Division 09 30 00* - Tiling: Ceramic washroom accessories.
E. *Division 09 90 00* - Painting and Coating
F. *Division 10 21 00* - Phenolic Toilet Compartments.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
E. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017 (Reapproved 2022).
F. ASTM C1036 - Standard Specification for Flat Glass; 2016.
G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
H. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.
I. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

1.06 QUALITY ASSURANCE

A. Provide products of the same manufacturer for each type of accessory unit and for units exposed in same areas. Provide lock units with same keying for each type of accessory unit in project wherever possible. Furnish two keys for each lock.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
    1. AJW Architectural Products: www.ajw.com.
    2. American Specialties, Inc: www.americanspecialties.com.
    3. Bradley Corporation: www.bradleycorp.com.
    4. Georgia-Pacific Professional: www.blue-connect.com.
    5. Bobrick Washroom Equipment Inc. of North Hollywood CA..
    6. Approved Equal.
    7. Substitutions: *Division 01 60 00* - Product Requirements.
B. Diaper Changing Stations:
    1. American Specialties, Inc: www.americanspecialties.com.
    2. Bradley Corporation: www.bradleycorp.com.
    3. Diaper Deck & Company: www.diaperdeck.com.
    4. Koala Kare Products: www.koalabear.com.
    5. Safe-Strap Company, Inc: www.diaperdepot.com.
    6. Approved Equal.
    7. Substitutions: *01 60 00* - Product Requirements.
C. Provide products of each category type by single manufacturer.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete

with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
1. Grind welded joints smooth.
2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Keys: Provide two keys for each accessory to Owner; master key lockable accessories.
C. Stainless Steel Sheet: ASTM A666, Type 304.
D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
F. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
G. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
H. Adhesive: Two component epoxy type, waterproof.
I. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
J. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturers for component and substrate.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.
B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.
C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
D. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.
E. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
F. Back paint components where contact is made with building finishes to prevent electrolysis.

2.04 COMMERCIAL TOILET ACCESSORIES

A. TD-1 Toilet Paper Dispenser: Owner Furnished, Contractor Installed.
B. PD-1 Paper Towel Dispenser: Owner Furnished, Contractor Installed.
C. PT-1 Paper Towel Dispenser: Owner Furnished, Contractor Installed.
D. SD-1 Soap Dispenser: Owner Furnished, Contractor Installed.
E. M-1 Mirrors: Stainless steel framed, 1/4-inch-thick annealed float glass; ASTM C1036.
1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
2. Size: 18 inches by 30 inches.
3. Frame: 0.05-inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
4. Backing: Full-mirror sized, minimum 0.03-inch galvanized steel sheet and non-absorptive filler material.

F. M-2 Mirrors: Stainless steel framed, highly polished No. 8 architectural finish, 20-gauge stainless steel
1. Size: 18” x 30”.
2. Frame: 0.05-inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
3. Backing: Full-mirror sized, minimum 0.03-inch galvanized steel sheet and non-absorptive filler material.

G. Grab Bars: GB -1, GB-2, GB-3; Stainless steel, peened surface finish.
1. Standard Duty Grab Bars:
a. Push/Pull Point Load: 250 pound-force, minimum.
b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05-inch wall thickness, exposed flange mounting, 1-1/2-inch clearance between wall and inside of grab bar.
c. Length and Configuration: As indicated on drawings.

H. ND-1 Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.

2.05 DIAPER CHANGING STATIONS

A. CS-1 Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.

1. Material: Polyethylene.
2. Mounting: Surface.
3. Color: Gray.
4. Minimum Rated Load: 250 pounds.

2.06 UTILITY ROOM ACCESSORIES

A. MH-1 Mop and Broom Holder: 0.05-inch-thick stainless steel, Type 304, hat-shaped channel.
   1. Holders: Four spring-loaded rubber cam holders.
   2. Length: 36 inches.
B. MH-2 Mop and Broom Holder: 0.05-inch-thick stainless steel, Type 304, hat-shaped channel.
   1. Holders: 3 spring-loaded rubber cam holders
   2. Length: 24 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify exact location of accessories for installation.
C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
D. Verify that field measurements are as indicated on drawings.
E. See Section 06 1000 for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.
B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
B. Install plumb and level, securely and rigidly anchored to substrate.
C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
   1. Grab Bars: As indicated on drawings.
   2. Mirrors: As indicated on drawings. from floor
   3. Other Accessories: As indicated on drawings.
D. Accessories shall be installed with fasteners recommended by manufacturers in manners to produce totally rigid installations. Contractor shall consult with Architect/Engineer at Project Site for exact locations of accessories where locations are not indicated on Drawings, or where indicated or proposed locations will interfere with other construction, door swings, light switches, etc.
E. Grab bars shall be mounted with metal devices and fastenings (no plastic permitted) as required by mounting conditions to develop capacity to resist downward pull of 300 pounds minimum.
F. Defective accessories shall be replaced with matching accessories at the expense of the Contractor.
G. Coordinate location of sanitary napkin disposal with the location of plumbing fitting at this wall to avoid conflict in servicing this unit.
H. Provide supplier of toilet partition with a template for all toilet accessories which are to be anchored to his partitions in order for the toilet partition fabricator to make provisions for reinforcing partitions.
   Each accessory shall be fastened rigidly in place, in perfect plumb, level, and alignment. Where an accessory is mounted on or in surface having joint pattern, it shall be mounted symmetrically within pattern. Surfaces of fastening devices exposed after installations shall have same finish as attached accessory. Exposed surfaces of accessories shall be protected with strippable plastic or other means until installation is accepted. Accessory manufacturer's mounting details shall be coordinated with other trades as work progresses.
I. Surface mounted accessories shall be installed with masonry anchors in masonry, or other approved fasteners as required by construction.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.
B. Adjacent wall surfaces and materials shall be protected during installation of accessories. Any

damaged adjacent materials or accessories shall be repaired or replaced at no cost to the Owner. Protect installed accessories until acceptance of the project by the Owner.

C. After inspection of the installation and approval, remove all labels and clean accessories. Adjacent work of other trades soiled by work under this section shall also be cleaned.

D. Upon completion of the accessory installation, remove from the job site all excess materials and debris and leave ready for final inspection.

DIVISION 10 44 00 – FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

CABINETS: Shall be semi-recessed installation. Breakable transparent glazing shall be scored Plexiglas. Wall-hung fire extinguisher types are allowed in mechanical/ electrical rooms, service platforms, and other services spaces.

FIRE EXTINGUISHERS: Shall be provided by the Contractor. 10 lbs. refillable/rechargeable type.

LOCATIONS: In addition to the code required minimums, MSCS requires an extinguisher cabinet near each exterior egress door.

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 RELATED REQUIREMENTS

A. *Division 06 10 00* - Rough Carpentry: Wood blocking product and execution requirements.

B. *Division 09 90 00* - Painting and Coating.

1.03 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

B. FM (AG) - FM Approval Guide; current edition.

C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

D. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Product Data: Provide extinguisher operational features.

C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

1.06 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain fire extinguishers and cabinets from one source from a single manufacturer.

B. UL-Listed Products: Fire extinguishers shall be UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:

1. Basis of Design: Larsen's Manufacturing Co; ; MP10: www.larsensmfg.com/#sle.
2. Activar Construction Products Group, Inc. - JL Industries; Cosmic Extinguisher - Multipurpose Chemical 10E: www.activarcpg.com/#sle.
3. Kidde, a unit of United Technologies Corp; PRO 210: www.kidde.com/#sle.
4. Nystrom, Inc; EX-3010: www.nystrom.com/#sle.
5. Potter-Roemer; 3010: www.potterroemer.com/#sle.
6. Approved Equal.

7. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Fire Extinguisher Cabinets and Accessories:
   1. Basis of Design: Larsen's Manufacturing Co; ; Model 2409-R2 : www.larsensmfg.com/#sle.
   2. Activar Construction Products Group, Inc. - JL Industries; Cosmopolitan Series: www.activarcpg.com/#sle.
   3. Nystrom, Inc; Summit, FC-7260: www.nystrom.com/#sle.
   4. Potter-Roemer; Dana 7260: www.potterroemer.com/#sle.
   5. Approved Equal.
   6. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Stored Pressure Operated: Deep Drawn.
   2. Class: A:B:C type. UL Rating 4A-80B:C.
   3. Size: 10 pound.
   4. Finish: Baked polyester powder coat, Red color.
   5. Temperature range: Minus 65 degrees F to 120 degrees F.
   6. Product: Larsen's MP10.

C. Wet Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gauge.
   1. Class: K type.
   2. Size: 2-1/2 gallons.
   3. Finish: Polished stainless steel.
   4. Temperature range: Minus 20 degrees F to 120 degrees F.
   5. Product: Larsen's WC 21/2

2.03 FIRE EXTINGUISHER CABINETS

A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

B. Cabinet Construction: Non-fire rated.
   1. Formed stainless steel sheet; 0.036-inch-thick base metal.

C. Fire Rated Cabinet Construction: One-hour fire rated.
   1. Steel; double wall or outer and inner boxes with 5/8-inch-thick fire barrier material.

D. Cabinet Configuration: Recessed type.
   1. Interior nominal dimensions of 9 1/2 wide by 24 inches high by 6 inches deep.
   2. Projected Trim: Returned to wall surface, with 5/16-inch projection, and 1 3/4-inch-wide face.
   3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim.

E. Cabinet Configuration: Semi-Recessed type.
   1. Interior nominal dimensions of 9 1/2 wide by 24 inches high by 6 inches deep.
   2. Projected Trim: Per specified model.
   3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim.
   4. Provide recessed handle.

F. Door: 0.036-inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degrees opening with two butt hinges.

G. Door Glazing: Acrylic plastic, clear, 1/8-inch thick, flat shape and set in resilient channel glazing gasket.

H. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

I. Fabrication: Weld, fill, and grind components smooth.

J. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.

K. Finish of Cabinet Interior: White colored enamel.

L. Product: Larsen's Architectural Series, Full Panel Door:

1. Metal stud walls - Model 2409-R2; FS 2409-R2 (Fire Rated).
2. CMU walls – Model 2409-R4; FS 2409-R4 (Fire Rated).
3. Surface mounted – Model 2712-SM.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.
   1. Product: Larsen's #846 for MP10.
   2. Product: Larsen's #1007 for WC 21/2.

B. Cabinet Signage:
   1. Lettering: FIRE EXTINGUISHER decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Contractor to maintain wall fire ratings around cabinets.
C. Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.
   1. Securely fasten fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.
   2. Where exact location of cabinets is not indicated, locate as directed by Architect/Engineer.
   3. Ensure that extinguishers are properly secured and properly charged according to the manufacturer's recommendations.
D. Place extinguishers in cabinets and at mounting heights indicated
E. Position cabinet signage at door.

3.03 CLEANING

A. Ensure all cabinets are clean and free of debris.
B. Ensure surfaces are clean from dirt, grease and loose rust and or mill scale.

3.04 MAINTENANCE

A. See *Division 01 70 00* - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
B. Provide a separate maintenance contract for specified maintenance service.

DIVISION 10 51 00 – LOCKERS

PART 1 GENERAL

New high school lockers shall be a single recessed in wall construction or have sloping tops and masonry end walls. New middle school lockers shall be double tiered and recessed in wall construction or have sloping tops and masonry end walls. Bases shall be provided by locker manufacturers unless noted otherwise. Use closed a closed base to provide a substrate for vinyl/ rubber base installation in lieu of open base unless noted otherwise. Base height shall be determined by vinyl/ rubber base specified, i.e. 4” or 6”. All lockers must be set on housekeeping pads.

STUDENT LOCKERS: Shall be of steel construction with a baked enamel finish. Doors shall be louvered with a recessed handle. Minimum size for student locker compartments shall be 12" x 36" x 12" deep. Middle and high schools shall use double-tier lockers where practical. Elementary schools shall use casework cubbies. Each installation of lockers shall include an appropriate number of accessible lockers with the accessible symbol attached to the locker door. All lockers shall have an integral pocket pull. Locks shall not be recessed. Lockers shall be specified with latch to accept a pad lock unless noted otherwise. The pad lock will be provided by MSCS. For Middle and High Schools, the Designer shall confirm with school if combination locks with master override key or pad locks are to be used for locking mechanism.

PHYSICAL EDUCATION LOCKERS: 12” x 12” x 36” Lockers. Provide perforated doors at compartments for gym and athletic clothes.

TEAM SPORTS LOCKERS: 18” x 18” x 72” Provide perforated doors for base bid.

1.01 SECTION INCLUDES

A. Metal lockers.
B. Solid plastic lockers.
C. Wood lockers.
D. ADA required lockers.
E. Locker benches.

1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
C. Shop Drawings: Indicate locker plan layout, and numbering plan.
D. Samples: Submit two samples 3 by 3 inches in size, of each color scheduled.
E. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

1.05 EXTRA MATERIALS

A. Provide full size units of the following hardware items equal to 10 percent of amount installed for each type and finish, but no fewer than 5 units.
    1. Number plates
    2. Hooks

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Lockers:
    1. Lyon Workspace Products: www.lyonworkspace.com/#sle.
    2. Penco Products, Inc: www.pencoproducts.com/#sle.
    3. Republic Storage Systems Co: www.republicstorage.com/#sle.
    4. General Storage Systems: www.generalstoragesystems.com .
    5. Approved Equal.
    6. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Solid Plastic Lockers:
    1. Scranton Products: www.scrantonproducts.com.
    2. ASI Storage Solutions: www.asi-storage.com.
    3. Approved Equal.
    4. Substitutions: See *Division 01 60 00* - Product Requirements.
C. Wood Lockers:
    1. List Industries: www.listindustries.com.
    2. Ideal Lockers: https://www.idealockers.com.
    3. Approved Equal.
    4. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 LOCKER APPLICATIONS

A. Metal Lockers: Single and double tier heavy duty knock down lockers.
    1. Width: LKR-1 - 15 inches, LKR-2 - 12 inches.
    2. Depth: LKR-1 - 15 inches, LKR-2 - 12 inches.
    3. Height: 72 inches.
    4. Fittings: Three single-prong wall hooks and one double-prong ceiling hook.
    5. Locking: Padlock hasps, for padlocks provided by Owner.
    6. Base: 4" zee base.
    7. Top: Continuous sloped.
B. Football Lockers: Single tier solid plastic (HDPE) athletic lockers.
    1. Width: 18 inches.
    2. Depth: 24 inches.
    3. Height: 72 inches.
    4. Fittings: Hanging storage with 4-hanging storage hooks.
    5. Locking: Owner provided locks.

6. Top: Continuous sloped.

C. Wood Athletic Lockers: Single tier solid plastic (HDPE) lockers, recessed mounted.
   1. Width: 24 inches.
   2. Depth: 24 inches.
   3. Height: 84 inches.
   4. Fittings: Coat rod, 3 coat hooks.
   5. Locking: Owner provided locks.
   6. Security box.

D. Locker Benches: Stationary type; bench top of laminated birch; chrome plated pedestals.
   1. Height: 1'-4"
   2. Length:6'-0"
   3. Thickness: 1-1/8"
   4. Width: 0'-9"
   5. Top to be completely sealed and finished with a coat of lacquer applied to all exposed surfaces.

2.03 METAL LOCKERS

A. Penco Invincible II basis of design.

B. Lockers: Factory assembled, made of formed sheet steel, ASTM A653/A653M SS Grade 33/230 with G60/Z180 coating, stretcher leveled; metal edges finished smooth without burrs; baked enamel finished inside and out.
   1. Where ends or sides are exposed, provide flush panel closures.
   2. Provide filler strips where indicated, securely attached to lockers.
   3. Color: To be selected by Architect/Engineer.

C. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
   1. Sides, Bottoms, Tops and Shelves: 16 gauge.
   2. Backs: 18 gauge.
   3. Metal Base Height: 4 inches.

D. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
   1. Door Frame: 16-gauge, minimum.

E. Doors: Hollow double pan, sandwich construction, 1-3/16 inch thick; welded construction, channel reinforced top and bottom with intermediate stiffener ribs, grind and finish edges smooth.
   1. Door Outer Face: 14 gage minimum.
   2. Door Inner Face: 18 gage minimum.20 gage, 0.0359 inch
   3. Provide holes for attaching number plates.
   4. Ventilation: Diamond perforated outer, offset diamond perforated inner pan.

F. Hinges: Two for doors under 42 inches high; three for doors over 42 inches high; weld securely to locker body and door.
   1. Hinge Thickness: 14 gage, 0.0747 inch.

G. Latching: Single point.
   1. Recess handle in door.
   2. Integral Pocket and Pull: brushed stainless steel securely fastened to door with two lugs and a positive tamper-resistant decorative fastener.
      a. Pocket Depth: Sufficient to prevent a combination padlock, built-in combination lock, or key lock from protruding beyond door face.
      b. Pull: Formed in pocket.
      c. Padlock Staple: Protruding through pocket.
      d. Firmly secure rubber silencers to locker frame.

H. Sloped Top: 18 gauge, with closed ends.

I. Trim: 18 gauge.

J. Coat Hooks: Stainless steel or zinc-plated steel.

K. Number Plates: Provide each locker with a polished aluminum number plate, 2-1/4 inches (57 mm) wide by 1 inch (25 mm) high, with black numerals not less than 3/8 inch (9.5 mm) high; attach to face of door with two aluminum rivets.

L. Finished End Panels: Minimum 16-gauge steel formed to match locker depth and height, 1 inch

(25 mm) edge dimension; finish to match lockers; install with concealed fasteners.

M. Front Fillers: 20-gauge steel formed in an angle shape, with 20 gauge slip joint angles formed in an angle shape with double bend on one leg forming a pocket to provide adjustable mating with angle filler.
   1. Attachment by means of concealed fasteners.
   2. Finish to match lockers.

N. Zee Bases for Knock-Down Lockers without legs: 14-gauge, steel flanged outward at top for support of lockers, flanged inward at bottom for anchoring to floor.
   1. Height: 4 inches (101 mm).

2.04 FOOTBALL LOCKERS

A. Manufacturer: Scranton Products Athletic Tufftec locker basis of design.

B. Lockers: Lockers to be constructed from High Density Polyethylene (HDPE) resins.

C. HDPE Components: To have a smooth "orange peel" finish. Locker doors and door frames to be the same color.
   1. Locker Doors and Frames: Made from high impact, high density polyethylene (HDPE) formed under high pressure into solid plastic components 1/2 inch (13 mm) thick with homogeneous color throughout.
   2. Sides, Tops, Bottoms, Backs, and Shelves: Made from high impact, high density, polyethylene (HDPE) formed under pressure into solid plastic components 3/8 inch (9.5 mm) thick with homogenous natural color throughout. Vertical back, outside, inside panels, horizontal top, bottom, divider, and shelves will be grey in color.
   3. End Panels: Filler panels of plastic material in color of locker unless noted otherwise as an accent color.
   4. Continuous Latch: Made from high impact HDPE plastic and capable of accepting various locking mechanisms. The spring-loaded latch shall be securely fastened to the entire length of the door providing a quiet positive latching function.
   5. Color: As selected by Architect/Engineer.
   6. Fasteners for Accessories and Locking Mechanisms: Tamperproof type.

D. Coat Hooks: Stainless steel or reinforced nylon; attached with tamperproof screws.

E. Number Plates: Manufacturer's standard, minimum 4-digit, permanently attached with adhesive; may be field installed.

F. Locks: Padlock hasp.

G. Locker Bases: Supplied 4 inches (102 mm) high, black unless otherwise specified. Fabricated from 3/4 or 1 inch (19 or 25 mm) black plastic. Bases are assembled in the field.

2.05 WOOD LOCKERS

A. Manufacturer: Recruiter Wood Sports Locker basis of design.

B. Lockers: Lockers to have full-curve sides, 12” wide security boxes, and footlocker with slanted front grate on 3” wood sleeper base (by installer).
   1. Locker Body: Shall be furniture grade ¾” Plain Slice Red Oak Plywood Hardwood or Veneer throughout finished with a catalyzed, clear, two-coat cabinet lacquer.
   2. Sides: Shall be furniture grade ¾” Plain Slice Red Oak Plywood Hardwood or Veneer throughout finished with a catalyzed, clear, two-coat cabinet lacquer.
   3. Tops, Bottoms: Shall be furniture grade ¾” Plain Slice Red Oak Plywood Hardwood or Veneer throughout finished with a catalyzed, clear, two-coat cabinet lacquer.
   4. Backs: Shall be furniture grade ¾” Plain Slice Red Oak Plywood Hardwood or Veneer throughout finished with a catalyzed, clear, two-coat cabinet lacquer.

C. Fasteners: Cadmium, zinc or nickel-plated steel; bolt heads, slot less type; self-locking nuts or lock washers.

D. Hinges: Continuous piano type hinge in bright brass plating.

E. Hardware: Hooks and hang rods of cadmium plated or zinc plated steel or cast aluminum.

F. Number Plates: To be polished aluminum with not less than 3/8" high etched numbers.

G. Locker Trim: Face trim, Shelf valances, personal effects locker doors, seat front nosing, seating hinge support blocking and seat support cleats to be fabricated from Red Oak Lumber. PVC edging will not be allowed.

H. Locks: Locker manufacturer's standard type of style indicated above.

I. Vertical Seams: Hardwood Oak Trim to be installed between each locker to eliminate vertical

seams. PVC edge banding will not be allowed.

J. Hanging Hooks: Double prong metal coat hooks.

K. Clothes Hang Bar: KV 1 1/6" diameter chrome plated steel, .075" wall thickness.

2.06 BENCHES

A. Benches: Laminated selected hardwood, 1-1/4 inch (31 mm) full finished thickness, corners rounded and sanded, surfaces finished with two coats of clear lacquer.
   1. Depth: 24 inches deep.
   2. Length: 42 inches long.

B. Heavy-Duty Bench Pedestals: Steel tubing with 11-gauge steel flanges welded to each end, 16-1/4 inches high, finish to match lockers.

2.07 FABRICATION

A. Fabricate the work true to dimensions, square, plumb and level. Accurately fit members with hairline joints. Secure intersecting members with appropriate fastenings.

B. Fabricate the finished work free from distortion and defects detrimental to appearances and performance.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify all dimensions on the site before proceeding with shop work.

B. Do not begin installation until substrates have been properly prepared.
   1. Clean surfaces thoroughly prior to installation.
   2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

A. Install lockers at the location shown in accordance with the manufacturers' instructions for plumb, level, rigid and flush installations.

B. Place and secure on prepared base.

C. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 lb.

D. Bolt adjoining locker units together to provide rigid installation.

E. Install end panels, filler panels, and sloped tops.

F. Install accessories.

G. Replace components that do not operate smoothly.

3.03 CLEANING AND PROTECTION

A. Clean locker interiors and exterior surfaces.

B. Clean, lubricate, and adjust hardware.

C. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit metal locker use during construction.

D. Correct marred finish, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended by locker manufacturers.

DIVISION 10 57 23 – CLOSET AND UTILITY SHELVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Laminated shelves.

B. Accessories.

1.02 RELATED REQUIREMENTS

A. *Division 06 10 00* - Rough Carpentry: Blocking in walls for attachment of shelving or storage system.

B. *Division 09 21 16* - Gypsum Board Assemblies: Blocking in metal stud walls for attachment of standards or mounting rails.

1.03 REFERENCE STANDARDS

A. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, with installation

instructions.

C. Shop Drawings: Provide drawings prepared specifically for this project; show dimensions of shelving or storage system and attachment to substrates.
D. Selection Samples: For each color selection required, submit color chips representing manufacturer's full range of available colors and finish.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store products under cover and elevated above grade.
C. Store flat to prevent warpage and bending.

PART 2 PRODUCTS

2.01 SHELVING APPLICATIONS

A. Shelf Depth: As indicated in drawings
B. Shelf Length: As indicated in drawings

2.02 MATERIALS

A. Laminated Shelves: Particleboard with thermal-fused melamine surface on top and bottom.
    1. Edge Finish: Hot-melt PVC edge banding, matching color.
    2. Substrate Thickness: 3/4 inch, nominal.
    3. Laminate: NEMA LD 3 Type HGL.
    4. Color: White.
B. Wall-Mounted Standards: Vertically slotted channel standards with double-tab cantilever brackets to suit shelving; factory finished to match shelving.
C. Mounting Hardware: Provide manufacturer's standard mounting hardware; include support braces, wall brackets, back clips, end clips, poles, and other accessories as required for complete and secure installation; factory finished to match shelving.
D. Fasteners: As recommended by manufacturer for mounting substrates.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect areas to receive shelving, to verify that spaces are properly prepared to receive shelf units and are of dimensions indicated on shop drawings.
B. Verify appropriate fastening hardware.
C. Do not begin installation until substrates have been properly prepared
D. If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, with shelf surfaces level.
B. Cap exposed ends of cut wires.
C. Install back clips, end clips at side walls, and support braces at open ends. Install intermediate support braces as recommended by manufacturer.
D. Mounting Heights:
    1. Other shelves: See drawings/instructions.

3.04 CLEANING

A. Clean soiled surfaces after installation.

3.05 PROTECTION

A. Protect installed work from damage.
B. Touch-up, repair, or replace damaged products before Substantial Completion in a manner that eliminates evidence of replacement.

DIVISION 10 70 16 – METAL CANOPIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Freestanding metal canopies.
B. Cantilevered wall-attached metal canopies.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Concrete footings.

1.03 *REFERENCE STANDARDS*

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
F. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
I. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.
J. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.
K. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
L. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.
M. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
N. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
O. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
P. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
Q. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Submit product data sheets, including material descriptions and finishes, and preparation instructions and recommendations.
C. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing profiles, sections of components, finishes, and fastening details.
D. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer.
E. Designer's Qualification Statement.
F. Manufacturer's Qualification Statement.
G. Erector's Qualification Statement.
H. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
I. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
   1. Comply with applicable code for submission of design calculations as required for acquiring permits.
   2. Cooperate with regulatory agencies or authorities having jurisdiction (AHJ), and provide data as requested.
B. Perform steel work in accordance with AISC 303.
C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
   1. Not less than three years of documented experience.
D. Erector Qualifications: Company specializing in performing the work of this section.
   1. Not less than three years of documented experience and approved by canopy manufacturer.
E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site ready for erection.
B. Package using methods that prevent damage during shipping and storage on site.
C. Store materials under cover and elevated above grade.

1.07 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals for additional warranty requirements.
B. Metal Canopies: Correct defective work within a two-year period after Date of Substantial Completion.
C. Finish Warranty: Provide manufacturer's ten-year warranty on factory finish against cracking, peeling, and blistering.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Canopies:
   1. Mapes Canopies (basis of design); www.mapescanopies.com/#sle.
   2. Austin Mohawk, Inc.: www.austinmohawk.com/#sle.
   3. Madison Industries: www.madisonind.com.
   4. Tennessee Valley Metals, Inc: www.tvmetals.com/#sle
   5. Approved Equal.
   6. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 METAL CANOPIES

A. Shop Fabricated Aluminum Canopy Type: Post Supported and Cantilever.
B. Configuration: Layout and dimensions, column layout, canopy clearance, fascia profile, and roof covering design as indicated on drawings.
   1. Installation: Freestanding post-supported.
   2. Installation: Cantilever-mounted to building structure with structural members above decking.
   3. Column Anchorage: Column baseplates installed with anchor bolts or expansion anchors into concrete footing, slab, or pier.
   4. Structural Framing System: Aluminum.
   5. Covering Material: Aluminum.
   6. Drainage Concept: Post-supported water collected in decking conducted into perimeter drain beams and discharged through columns.
      a. Cantilever: Water collected in decking conducted into perimeter gutter fascia and discharged through field located scupper at bottom of gutter.
C. Performance Requirements:
   1. Design and fabricate metal canopy system to resist wind, snow, live, and seismic loads without failure, damage, or permanent deflection in accordance with ASCE 7:
      a. Loads: As indicated on structural drawings.
   2. Thermal Movement: Design canopy system to accommodate thermal movement caused by

ambient temperature range of 120 degrees F and surface temperature range of 180 degrees F without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects on assembly components.

3. Electrical Components, Devices, and Accessories: Listed and labeled by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction and installed in compliance with NFPA 70, and marked for intended application.

2.03 COMPONENTS

A. Structural Steel Framing:
   1. Columns: ASTM A500/A500M, Grade B, round or rectangular tubing, sized to suit project design load requirements.
   2. Base and Top Plates: ASTM A36/A36M, with pre-drilled bolt holes.
   3. Beams: Wide flange, ASTM A572/A572M Grade 50.
   4. Other Structural Steel Members: ASTM A36/A36M.

B. Structural Aluminum Framing (columns and beams): Alloy and temper 6063-T5, 6063-T6, or 6061-T6.
   1. Extruded Shapes and Tubes: ASTM B221 (ASTM B221M).
   2. Rolled or Extruded Structural Shapes: ASTM B308/B308M.
   3. Extruded Structural Pipe and Tube: ASTM B429/B429M.
   4. Sheet and Plate: Alloy 5052, 5005, or 6061-T651, ASTM B209/B209M.

C. Covering:
   1. Aluminum Decking:
      a. Interlocking extruded aluminum decking modules.
         Extruded Decking: 6 inches wide by 2 ¾ inches high by 0.078-inch thick, smooth, interlocking planks ASTM B209/B209M, Alloy 5052, 5005, or 6061-T651.
      b. Decking Orientation, post-supported: Parallel to wall.
      c. Decking Orientation, cantilever: parallel to wall.

D. Fascia: Manufacturer's flat profile of height indicated on drawings.
   1. Material: Extruded panel.

E. Anchor Bolts: ASTM A307 or ASTM A572/A572M, formed with bent shank, assembled with template for casting into concrete.
   1. Minimum exposed thread of 7 inches above footing and 23-inch minimum embedment.
   2. Provide nuts and washers as required for column leveling and plumbing.

F. Concrete Footings: Refer to *Division 03 30 00* for additional requirements.

2.04 SHOP FABRICATION

A. Provide a complete system ready for erection at project site.
B. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.
C. Weld steel members in accordance with AWS D1.1/D1.1M.
D. Weld aluminum members in accordance with AWS D1.2/D1.2M.
E. Fabricate connections for bolt, nut, and washer connectors.

2.05 FINISHES

A. Structural Steel Framing:
   1. Shop Primer: Rust-inhibitive red oxide.
   2. Finish Coating: As specified in *Division 09 90 00*.

B. Aluminum Framing and Decking:
   1. Superior Performing Organic Coatings: AAMA 2605, multiple coats, thermally cured, polyvinylidene fluoride system.
   2. Color: To match SW 7669 Summit Gray.

2.06 ACCESSORIES

A. Structural Bolts: ASTM F3125/F3125M, Grade A325, minimum 3/4-inch diameter.
B. Trim, Closure Pieces, and Flashings: Same material, thickness and finish as sheet metal decking; factory-fabricated to required profiles.
   1. Exposed Fasteners: Not permitted.
C. Grout: ASTM C1107/C1107M; non-shrinking; premixed compound consisting of non-metallic aggregate, cement, water-reducing and plasticizing agents.
D. Fasteners, Non-Structural: ASTM F593 stainless steel or ASTM A307 carbon steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and site area for conditions that might prevent satisfactory installation.
B. Verify that foundation, electrical utilities, and placed anchors are in correct position.
C. Verify that bearing surfaces are ready to receive this work.
D. Do not proceed with installation until all conditions are satisfactory.

3.02 INSTALLATION - FRAMING

A. Erect framing in accordance with AISC 303.
B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation.
C. Set column base plates with non-shrink grout to achieve full plate bearing.
D. Fasten columns to anchor bolts.
E. Do not field cut or alter structural members without approval.
F. After erection, prime welds, abrasions, and surfaces not shop primed.

3.03 INSTALLATION - CANOPY COVERING

A. Install in accordance with manufacturer's instructions.
B. Fasten metal decking to metal support members, aligned level and plumb.
C. Install fascia panels, trim, and flashing.
D. Separate dissimilar metals using concealed bituminous paint.
E. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.04 TOLERANCES

A. Maximum Variation from Level: Plus/Minus 1/8 inch.

3.05 CLEANING

A. See *Division 01 70 00* - Execution and Closeout Requirements for additional requirements.
B. Clean surfaces of dust and debris; follow manufacturer's cleaning instructions for the finish used.

3.06 PROTECTION

A. Protect canopy after installation to prevent damage due to other work until Date of Substantial Completion.

DIVISION 10 70 20 – FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum Flagpoles.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Concrete base and foundation construction.

1.03 REFERENCE STANDARDS

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2016 (Reapproved 2020).
B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
D. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2012.
E. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on pole, accessories, and configurations.
C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.
D. Operation Data: Provide operating data for the controller and timer.
E. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed the State in which the

Project is located.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flagpoles:
   1. American Flagpole: www.americanflagpole.com.
   2. Concord Industries, Inc; Basis of Design: www.concordindustries.com.
   3. Pole-Tech Co, Inc: www.poletech.com.
   4. Approved Equal.
   5. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 FLAGPOLES

A. Basis of Design: Flagpole shall be similar to Concord Industries and fabricated from all new seamless 6063-T6 aluminum tubing, 0.188 inches (3/16") thick minimum and be designed to withstand winds of 150 mph minimum unflagged. Flagpole shall have 25'-0" exposed height, and be fabricated in one piece. Shaft shall be approximately 6" diameter at 12' high. Finish to be clear anodized.
B. Flagpoles: Designed in accordance with NAAMM FP 1001
   1. Material: Aluminum.
   2. Design: Straight shaft.
   3. Mounting: Ground mounted type.
   4. Outside Butt Diameter: 7 inches.
   5. Outside Tip Diameter: 3.5 inches.
   6. Nominal Wall Thickness: 0.188 inches.
   7. Nominal Height: 25 ft; measured from nominal ground elevation.
   8. Halyard: Interior type.
C. Performance Requirements:
   1. Flagpole With Flag Flying: Resistant without permanent deformation to 125 miles/hr wind velocity; non-resonant, safety design factor of 2.5.
   2. Flagpole Without Flag: Resistant without permanent deformation to 185 miles/hr wind velocity; non-resonant, safety design factor of 2.5.

2.03 POLE MATERIALS

A. Aluminum: ASTM B241/B241M, 6063 alloy, T6 temper.

2.04 ACCESSORIES

A. Finial Ball: Stainless steel, 6-inch diameter.
B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.
C. Flag: American design; 60 by 96-inch size, nylon fabric, brass grommets, hemmed edges. Basis of Design: Dupont 200 Demier nylon:
   1. One (1) American Flag 5' x 8'.
   2. One (1) State Flag 4' x 6'.
D. Cleats: 9-inch size, aluminum with galvanized steel fastenings, two per halyard.
E. Cleat Box: Aluminum, with built-in hinge and hasp assembly, attached to pole with tamper proof screws inside box.
F. Halyard: 5/16-inch diameter polypropylene, braided, white.
G. Connecting Sleeve For Multiple Section Poles: Same material as pole, precision fit for field assembly of pole, concealed fasteners.
H. Primer: Zinc chromate type.
I. Basis of Deign: Fittings and Accessories:
   1. Ball (8" dia.) shall be fabricated from #14-gauge aluminum with flush seam.
   2. Truck shall be cast aluminum, double halyard, revolving, non-fouling type, complete with stainless steel ball bearings and two 2-3/8" minimum diameter cast nylon sheaves.
   3. Two sets of #10, 5/6" minimum with waterproof polypropylene halyards shall be provided, each equipped with two chrome swivel snaps to secure flag.
   4. Two 9" cast aluminum cleats complete with tamperproof stainless steel socket head bolts shall be included.

5. Base of flash collar, shall be spun aluminum. Diameter of collar shall be 1" minimum larger than diameter of foundation sleeve.

2.05 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16-gauge, 0.0598-inch steel, galvanized, depth as indicated.
B. Pole Base Attachment: Flush; steel base with base cover.
C. Lightning Ground Cable: Copper No. 6 AWG, soft drawn.

2.06 FINISHING

A. Metal Surfaces in Contact With Concrete: Asphaltic paint.
B. Aluminum: Mill finish.
C. Finish: Spun finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concrete foundation is ready to receive work, and dimensions are as indicated on shop drawings.

3.02 PREPARATION

A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.03 INSTALLATION

A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.
B. See Structural drawings for placement of anchor devices and foundation sleeve.
C. Electrically ground flagpole installation.
D. Fill foundation tube sleeve with concrete specified in Section 03 3000.
E. Install foundation plate and centering wedges for flagpoles base set-in concrete base and fasten.
F. Install lightning protection in accordance with manufacturer's recommendations and as per approved Shop Drawings and local code requirements.
G. Excavation width and depth shall be as indicated on the Drawings.
H. Set the foundation tube into the excavated hole as per detail on approved Shop Drawings and manufacturer's recommendations. Make certain that the grounding spike is properly grounded.
I. Fill the excavation in one pour with Class A 3,000 psi compressive strength concrete to the elevation indicated on the Drawings.
J. After the concrete has cured at least 14 days, erect the flagpole. The pole shall be centered plumb and true in the tube with temporary wood wedges and then the tube shall be filled with screened dry sand and thoroughly tamped at 6" intervals. The tamped sand shall be thoroughly moisture sealed with 2" of sealant. After the installation has been inspected and approved by the Owner's Representative, base shall be lowered into place.
K. Install all accessories according to the recommendations of the manufacturer.
L. Replace any part that has been damaged during installation or that has not been properly installed. Where the aluminum finish has become stained or discolored, it shall be cleaned or have finish restored in accordance with recommendations of the Architectural Aluminum Manufacturer's Association.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1 inch.

3.05 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

DIVISION 11 00 00 – MISCELLANEOUS EQUIPMENT

ART ROOM KILN: Kiln to be installed if required by program. Kiln to be Owner-provided by preferred vendor. Provide proper electrical outlet. Coordinate voltage with owner (typically 240 volts, 1 phase, 48 amps. Use Amaco EX-270 as a basis of design. Provide exhaust fan and heat detector, mounted in an exhaust hood if required, tied to electrical so that exhaust fan operates when the kiln is in use and continues to operate until the kiln is cool. Provide a vent to the outside for kiln vent system. MSCS recommends locating Kiln Room on exterior wall.

DIVISION 11 06 40 – FOOD SERVICE EQUIPMENT

GENERAL

Food service equipment shall be bid as a part of the prime general construction contract with Owner supplied and Contractor installed. Coordination with the Central Nutrition Center administrative staff is critical in this process to determine specific equipment for fire protection, mechanical, electrical, and plumbing requirements for the requested equipment.
Refer to APPENDIX D - CAFETERIA AND KITCHEN DESIGN GUIDELINES for Owner's detailed instructions on kitchen design.

WALK-IN COOLERS AND FREEZERS: Concrete floor slabs will be recessed as required so that kitchen finished floor and freezer/ cooler floors are at the same level and material (thick set quarry tile required in new kitchens) as the Kitchen floor for food cart operation. If other drains are not used, provide floor drains near and outside the cooler and freezer and run copper drain from evaporators into this floor drain. Locate temperature controls and thermometers on the outside near the cooler and freezer doors. Temperature setting for the cooler shall be 35°F and temperature for freezer shall be minus 10°F. Provide properly constructed insulated floor slab where units are not constructed with integral insulation.

Provide electrical heat strip around freezer door to prevent freeze-up of door. FUEL SHUT-OFF: Provide automatic type, as required by code.

FIRE EXTINGUISHING SYSTEM: Provide under-hood fire protection system, as required by code. The construction documents shall be fully Coordinated between the hood equipment and fire protection, mechanical, electrical, gas, and plumbing utilities as required by code for proper operation and life safety protection.

1.01 SUMMARY

A. GENERAL DESCRIPTION: Food service equipment indicated on the contract drawings including general and supplementary conditions, schedules, equipment list and specifications associated with this section.
B. THE GENERAL PROVISIONS of the Contract including General and Supplementary Conditions, Division 1 General Requirements and instruction to Bidders apply to the Work included in this Division.
C. RELATED SECTIONS
   1. Division 1 - General Requirements
   2. Division 22 - Plumbing
   3. Division 23 - Mechanical
   4. Division 26 – Electrical

1.02 REFERENCES

A. National Sanitation Foundation Standards and recommended criteria. Provide each equipment item with NSF 'Seal of Approval'.
B. Underwriters Laboratories Standards and carry the U and/or cUL label.
C. ANSI standards for electric powered and gas burning equipment.
D. National Fire Protection Association Codes
E. All applicable health codes.
F. National Electric Code
G. Americans with Disabilities Act
H. Food and Drug Administration HACCP Guidelines
I. American Gas Association

1.03 SUBMITTALS

A. PRODUCT DATA
   1. Brochures shall be bound in book form in item numerical order. Each product data sheet will be preceded by a type written description indicating the item number, specification, manufacturer, model number, accessories and modifications to meet the intent of the specifications. Each manufacturers cut sheet will be marked, with model number, accessories and specific voltage.
   2. Provide six sets to the Architect for written approval before ordering equipment. Provide wiring diagram for all equipment as requested by the Architect.

B. SHOP DRAWINGS
   1. Provide three sets of drawings and one set of reproducible shop drawings of fabricated equipment with details showing all dimensions and all details of construction, installation and relation to adjoining and related work, where same requires cutting, field welding or close fitting, and shall show all reinforcement, anchorage and other work required for complete installation. Drawings shall be drawn to a scale of not less than ½" = 1'
   2. Mechanical/electrical rough-in drawings will be submitted in item number sequence indicating the utility requirements of each piece of equipment specified herein. These submittals will be accurately drawn to scale and include all necessary dimensions indicating elevations and distances from centerline of columns, walls, etc. The Contractor shall be responsible for determining the exact location of the outlets on walls and floors, where applicable, and not as it exists on the equipment. Allowances shall be made for traps, ells, valves, faucets, tailpieces, etc. Rough-in drawings shall include utility requirements for existing and future equipment indicated in specifications and drawings. Provide three sets of drawings and one set of reproducible shop drawings.
   3. Provide itemized equipment schedule including quantities, description, manufacturer, utility requirements and pertinent remarks.
   4. NOTE: CUTSHEET SUBMITTALS TO HAVE SPECIFIC ITEMS, VOLTAGES, DETAILS, OPTIONS AND ACCESSORIES CLEARLY OUTLINED HIGHLIGHTED TO MINIMIZE FIELD QUESTIONS FROM SUBCONTRACTORS.
      a. FAILURE TO OUTLINE SPECIFIC ITEMS WILL RESULT IN AUTOMATIC REJECTION OF CUTSHEET SUBMITTALS.
   5. Upon approval of all drawings and product data sheets, submit eight sets of all submittals bound in brief form, for final distribution.
   6. None of the above to be issued for work in field until all submittals have been stamped accepted.

C. GENERAL: Submit in accordance with Section 01330
   1. Submittals to be received by consultant no later than 10 working days after award of contract. Shop drawings will be in CAD Release 11 or later format.
   2. No Alternates will be allowed after the bid. All requests for alternates will be written and must be received by the Consultant no later than 7 days prior to the bid date.
   3. Only Food Service Equipment Contractors may request alternates.

D. SAMPLES
   1. Submit samples of all materials required by the Architect. Samples shall be adequate in size and quantity for testing their compliance with these specifications. These are to be submitted and approval obtained before work proceeds. Feet, handles, hardware, etc., shall be submitted with shop drawings if these items are not in accordance with specifications.

E. WARRANTY
   1. Warranty installed units will be free of defects in material and workmanship for a minimum of one year from date of substantial completion, all work as furnished by FSEC under these specifications. This warranty shall cover replacement of defective material, transportation and labor, but does not include cost of parts and labor caused by the Owner's carelessness or misuse of equipment.
   2. Warranty sealed compressor units for 5 years from date of substantial completion.
   3. Owner will contact FSEC for warranty service or repair and shall not be expected to contact any other agency.
   4. Owner shall have continued use of defective equipment until replacement is provided.
   5. Furnish In accordance with General Requirements, six (6) sets of operating and maintenance manuals and forward same to Architect for transmittal to Owner.
   6. For maintenance purposes, provide copy of accepted shop drawings, parts lists, specifications and manufacturer's maintenance bulletins for each piece of equipment.
   7. Provide name, address and telephone number of the Kitchen Equipment Contractor, manufacturer's representative, manufacturer and service company for each piece of equipment so that service or spare parts can be readily obtained.
   8. Provide an operation video for each piece of equipment that requires mechanical or

electrical operation and service. These videos will include the standard format for safe operation, cleaning and regular maintenance.

F. PRICING
   1. Submit a separate price for the food service package and supplies and a price for the installation of the equipment which will be performed as a subcontract to the project general contractor.
   2. Provide without additional cost to the Owner, all appurtenances and accessories which may not be specified or shown on Drawings, but which are required for the proper and safe functioning of equipment.
   3. ITEMS MARKED ON SCHEDULE AS DEDUCTIVE ALTERNATES (DA) ON EQUIPMENT SCHEDULE MUST BE PRICED INDIVIDUALLY.

1.04 QUALITY ASSURANCE

A. QUALIFICATIONS
   1. Manufacturer's qualifications: Firms regularly engaged in the manufacturing of food service equipment of types, capacities and sizes specified in this section, whose products have been in satisfactory use for not less than 5 years.
   2. Fabricator's qualifications: Firms with at least 5 years' documented experience in the fabrication of work specified in this section. Fabricated items will meet all code and standard requirements.
   3. Installer's qualifications: Acceptable to manufacturers, with at least 5 years of successful food service equipment installation experience on projects of similar scope.

B. PRE-INSTALLATION MEETING
   1. Conduct pre-installation meeting in accordance with Section 01200.
   2. Convene pre-installation meeting one week prior to commencing work of this section.

1.05 SYSTEM DESCRIPTION

A. EXTENT OF WORK - As identified in the drawings, schedules and specifications as it relates to this section.

1.06 OWNER'S INSTRUCTIONS AND MAINTENANCE - REFER TO SECTION 01700 FOR THE GENERAL REQUIREMENTS FOR CONTRACT CLOSE-OUT.

PART 2: PRODUCTS

2.01 MATERIALS / EQUIPMENT

A. PRODUCTS
   1. SCHEDULE: See Part 4 - Schedule of Product Descriptions
   2. MECHANICAL REQUIREMENTS: Refer to Division 23 for required drain traps, steam traps, atmospheric vents, valves, pipes and pipe fittings, ductwork and other materials necessary to complete mechanical hook-up which is not included in section 110640. Roof penetrations for refrigeration conduit must be coordinated with Roofing Contractor prior to roofing installation. Surfaces adjacent to exhaust hoods and cooking equipment must comply with NFPA 96 General Requirements. Connection of equipment to utilities not included in Section 110640.
   3. ELECTRICAL REQUIREMENTS: Refer to Division 26 for wiring, disconnects, and other materials necessary to complete electrical hook-up which is not included in Section110640. Roof penetrations for refrigeration conduit/wiring must be coordinated with Roofing Contractor prior to roofing installation. Connection of equipment to utilities not included in Section 110640.
   4. CUSTOM FABRICATION STANDARDS
      a. Stainless Steel: Where specified, it shall be Austenitic 18-8, Type 302 #4 commercial finish with a content of 17 percent to 19 percent chrome, 7 to 9 percent nickel with a maximum carbon content of 9 to 11%.
      Galvanized Iron: Where called for, it shall be galvanized on an 8 percent copper bearing alloy sheet, with an approved hot pure zinc galvanizing. Where galvanized iron has been welded, all seams shall be cleaned and scale removed and finished with a prime coat of aluminum paint. Galvanized iron shall be one of the following: Armco, Toncan, Keystone Copper Bearing.
      b. Field Joints / Welding: Field joints shall be located for practical construction with sizes convenient for shipping and entry into building spaces. All field joints shall be fully

(continuous) welded with same type metal, ground smooth and polished to the original finish of the metal.

c. Sound Deadening undercoat: Underside of all custom fabricated stainless steel tabletops shall be coated with 1/8" thick water-proof mastic material, non-asphaltic base.

d. Legs, Bracing and Feet: Legs and cross bracing shall be constructed of not less than1-⅝" o.d. stainless steel tubing, cold drawn, annealed and pickled, spaced not more than 6'-0" on center. Tops shall be braced below with a minimum of 2 each inverted type stainless steel welded hat channels. Stainless steel bullet feet shall have a minimum adjustment of 1-½" without the use of tools and be fully sealed.

5. MILLWORK FABRICATION: Custom equipment fabricator shall provide and install millwork items as indicated in this section in conformance with the Architectural Woodwork Institute standards for "custom grade" work.

B. MANUFACTURERS: Subject to compliance with requirements, provide custom fabrication products of one of the following or acceptable equivalent.
1. American Food Service 735 Florence Rd. Savannah, TN. 38372
2. Low-Temp Manufacturing 1947 Bill Casey Parkway Jonesboro, Georgia 30236
3. Atlanta Custom Fabricators, 4381 Industrial Access Rd, Douglasville, GA 30134
4. BSI Designs, 601 E. 64th Ave Denver, CO 80229

2.02 FINISHES - SEE SCHEDULE

2.03 ACCESSORIES – UNITS TO INCLUDE ALL PARTS AND FITTINGS FOR A COMPLETE OPERATION.

PART 3: EXECUTION

3.01 EXAMINATION OF SITE

A. REFER TO DIVISION 1 for General Re016quirements
1. Before submitting prices or beginning work, thoroughly examine the contract documents.
2. No claim for extra compensation will be recognized if difficulties are encountered, which examination of site conditions and contract documents prior to executing contract would have revealed.
3. Food Service Equipment Contractor is responsible for verification of and coordination with all dimensions, quantities, finishes, field dimensions and roughing of utilities for the equipment to be installed. Food Service Equipment Contractor is responsible for verifying there are no conflicts between the documents published by the Architect, Engineers and Consultant. Should the Food Service Equipment Contractor fail to verify and coordinate as stated, he shall without cost to owner, make any necessary modifications to the equipment to complete proper installation to the satisfaction of the Architect and Consultant.
4. Inspect all equipment described as "Owners" or "Existing" that is to be reused to verify condition, serviceability and utility requirements.

3.02 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01600.
B. Receive food service equipment in factory fabricated containers, inspect for damage and hold in warehouse.
C. Hold equipment in original containers in a location to provide adequate protection without interfering with other construction operations.
D. Handle equipment to avoid damage to components, enclosures and finish. Do not install damaged equipment.
E. Provide all necessary equipment and manpower to receive and handle equipment on job site with deliveries based on project schedule.

3.03 PREPARATION

A. Various items are specified herein by model number, brand name, trade name or name of manufacturer. It is the intent of this specification that the exact product be provided as specified. This requirement is not intended to restrict competition, and consideration will be given to other brands that are equal or better in every respect. However, no substitutes or alternates will be acceptable if not submitted in writing and approved by the Consultant seven (7) calendar days prior to the bid.

B. The decision as to acceptance or rejection of any alternate proposed shall be that of the owner and/or architect or his consultant, and their decision shall be final.
C. If equivalent products are submitted and accepted, Food Service Equipment Contractor shall be responsible for any costs arising from mechanical changes due to relocation of connections or utility requirements other than those indicated on mechanical drawings and specifications.
D. Upon acceptance of bid and consummation of contract, Food Service Equipment Contractor shall designate, by letter to the Architect, one individual of his organization who shall thereafter act as his representative in all negotiations and instructions given his representative shall be valid and binding on this contractor.

3.04 CONSTRUCTION / INSTALLATION

A. Definitions:
   1. "Owner" means the person or entity identified as the Owner or Operator (and agents thereof) in the Contract Agreement, or Owner's designated agent(s).
   2. "Contractor" means the person or entity identified as such in the Contract Agreement.
   3. "Equipment" means all items specified in Part 4.01 of this document as well as all materials, parts, fittings, connectors and other items necessary for a complete installation and proper operation in compliance with manufacturer's instructions and all applicable codes.
   4. "Install" means performance of all operations connected with installation work including but not limited to: unloading/unpacking materials and equipment to be installed, assembling equipment, supplying all necessary tools, materials, parts, connectors and fittings necessary for complete installation, cleaning, conditioning, calibrating, testing and readying equipment for proper operation and service.
   5. Owner Supplied, Contractor Installed (OSCI): Owner/Operator shall supply and deliver to the job site all items of equipment. The Contractor shall then perform all work necessary for installation of said equipment
   6. Contractor Supplied, Contractor Installed (OSCI): Contractor shall supply and deliver to the job site all items of equipment specified in Part 401 of this document and perform all work necessary for installation of said equipment.
B. All products, materials and equipment shall be applied, installed, connected, used, cleaned and conditioned in accordance with manufacturer's printed or electronically transmitted instructions (unless specified herein), all applicable government codes, and approved drawings for other contractors to make final electrical, gas, water, waste, ventilation and all utility connections.
C. Install units, plumb, square, level and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction.
D. Remove all packing material/straps and install all accessories in preparation for start-up and check-out.
E. Verify all utility connections have been properly completed.
F. Manage schedule so as to have all equipment connected and tested not less than five days prior to Owner's scheduled takeover date.

3.05 FIELD QUALITY CONTROL

A. General: Comply with requirements of Section 01450.
B. After all utility connections have been made by other contractors, The Food Service Equipment Contractor shall conduct final test in presence of Architect, Consultant, Owner and/or their designate to ensure that all equipment is ready for operation as required.
C. Each item of mechanically or electrically operated equipment shall be started, demonstrated and checked for proper operation by manufacturer's representative. Owner's representatives will be instructed in the proper operation and maintenance of all equipment and provide training for Foodservice Staff by factory trained Chef with no charge for future follow-up training.
D. Food Service Equipment Contractor's Representative will be on project site during working hours the first day of complete owner operation to assist as required.
E. Food Service Equipment Contractor shall provide letter stating the accomplishment of 3.05-C above. Include name of Food Service Equipment Contractor's representative who supervised instruction/demonstration as well as statement that owner's operations personnel thoroughly understand the proper operation and maintenance of all equipment and so signify by signing. Final Inspection of work shall not be contemplated prior to receipt of this documentation by

architect/consultant.

3.06 ADJUSTING, CLEANING AND PROTECTION OF WORK

A. Adjusting:
   1. Start-up, calibrate, and verify proper operation of all equipment no later than 72 hours prior to demonstration or receiving food product.

B. Cleaning:
   1. Food Service Equipment Contractor shall remove from project site all trash created by equipment installation on a daily basis.
   2. Prior to final inspection and owner operation, Food Service Equipment Contractor shall remove all protective coatings, thoroughly clean and service all equipment.

3.07 EXISTING ITEMS

A. In the event that existing equipment is designated on the equipment schedule and/or Specifications, the FSEC shall ensure that any and all such equipment is removed from the original location, cleaned, repaired/modified as required for proper operation, stored and re-installed as dictated by the project schedule.

B. It is the responsibility of the Food Service Equipment Contractor to review all existing equipment prior to submitting a bid to verify equipment condition and utility requirements.

C. Existing equipment will be warranted serviceable for a period of 90 days from substantial project completion.

3.08 ENERGY AND UTILITY DISTRIBUTION POLES

A. Provide and install where shown on floor plan, island style Energy Distribution and Control System. Units shall be manufactured in accordance with the latest edition of the NEC, NEMA, NFPA pamphlet 96 and 54, uniform plumbing code, ASME and OSHA, with UL listed bureau of mines rated and A.G.A and certified components.

B. Raceway system shall be completely pre-wired and pre-plumbed to final connection points for electric, hot water and cold water, for the equipment as shown on drawing.

C. CONSTRUCTION
   1. Fixed riser and raceway exterior panels shall be constructed of no.16 ga. type no.304 stainless steel with a no. 4 mill finish.
   2. Removable panels shall be constructed of no. 18 ga. stainless steel.
   3. Provide watertight barrier between plumbing and electrical compartment.
   4. Units shall be provided with neoprene bumper strips where applicable.

D. ELECTRICAL
   1. Electrical compartment shall be completely enclosed sheet metal housing, accessible by removal of concealed screws.
   2. Internal electrical main feeders shall be cable bus type having balanced load and phases. Breaker to be located on the same steel. plate housing their respective outlets.
   3. Cable bus shall be manufactured from insulated copper cable and mounted on non-conductive insulators, spaced at 24” maximum centers.
   4. Field joints (if required) shall be connected by securing wiring in terminal strips located at the respective field joint.
   5. Branch circuit wiring for each electrical connection shall be phase identified and sized in accordance with circuit breaker rated ampacity.
   6. Provide 4.5” x 12”, 16 ga. stainless steel breaker plate for each electrical connection. Connection plate shall also be equipped with grounding type receptacle having specific NEMA polarized configuration and metallic label with permanently lettered electrical characteristics.
   7. Plates shall be spaced on 12” center, and readily interchangeable by maintenance personnel to facilitate changes, additions and deletion of equipment.
   8. Provide blank plates for future equipment, & (1) 20amp convenience outlet.
   9. All 15 & 20 amp. 120/1Ø outlets require Ground Fault Current Interrupters (GFCI).

E. MAIN ELECTRICAL DISCONNECT BY OTHERS
   1. 80 Amp. 120/208/1Ø, main service electrical disconnect shunt type circuit breaker mounted in control tower ST-1.

F. PLUMBING
   1. Plumbing compartment shall be isolated from electrical compartments.

2. All piping and disconnects in system shall be colored.
3. Field joints shall be secured by tightening unions.
4. All hot and cold water piping, including individual branch pipe connections, shall be hard temper type "L" copper tubing with copper sweat type solder fittings.
5. Each branch connection shall be provided with brass double shut-off quick- disconnect, and flexible hose connector consisting of brass bellows type corrugated hose with braided stainless steel restrainer and polytech coating allowing a smooth surface for cleaning.
6. Provide (1) each .5” diameter hot water plumbing manifolds.
7. Provide (1) each .5” diameter cold water plumbing manifolds.

G. INSULATION
1. All water lines shall be covered with 3/8” thermal closed cell pipe insulation per ASTM-E90-C.

H. SHUT-OFF VALVES
1. Provide quarter turn ball type shut-off valves for all water main incoming services.

PART 4: SCHEDULES

4.01 EQUIPMENT:

A. The following schedule lists the equipment as required.
1. 24” DEEP SHELVING, to be to be Metro Super Erecta wire shelving in sizes shown on plan with “Metroseal 3" anti-microbial coating, (4) tiers of Metroseal 3 shelves on (4) 74" SiteSelect posts, plastic split sleeves included, lifetime warranty against rusting, NSF.
   a. NOTE: Verify size to space allocated.
   b. Alternate manufacturers using the same specifications:
   c. Hodges Nexel
2. COMBINATION WALK-IN COOLER/FREEZER, to be custom manufactured by Kolpak Corporation in size, shape and configuration as shown in drawing and corresponding detail. Two- compartment unit to be constructed of NSF foamed-in-place urethane panels, UL classified with flame spread rating of 20. Interior wall and ceilings finished in 26-gauge white stucco galvanized steel, exterior exposed panels finished in 22-gauge stainless steel #3 finish.
   a. The unit is to have an interior finished height of approximately 9' 2-¼ " with 4” reinforced galvanized insulated floor panels installed in such a way as to allow a top coat of thickset grout and tile as shown on detail drawing.
   b. Freezer internal dimensions to be22' - 4" W x 15' - 3" D x 8' – 6" H Cooler internal dimensions to be 16' - 6" W x 15' - 3" D x 8’ - 6" H
   c. Overall exterior dimensions to be 39' – 11" W x 15' - 11" D x 9' – 2" H
   d. Stainless steel closure strips are to be provided to cover gaps from walk-in panels to walls and ceilings to seal the joints in a sanitary manner. Flush-mount magnetic infitting self-closing padlockable door, 34" W x 77" H, for tile application, with cam-rise hinges and brushed hardware, fully programmable system 100 walk-in monitoring system, audio/visual temperature alarm & digital thermometer, door frame heater wire, vapor proof 48" LED light & switch with pilot light. Lights located per plan. Alarm system shall actively monitor and control door heater assembly for proper operation and lower energy consumption by having programmable initiation temperature. Termination temperature and percentage of operation time adjustability.
   e. An adjustable wiper gasket shall be mounted along the bottom edge of door. Lower 36 inches of door and support panels are to be finished both inside and out with high heavy duty 3/16" tread-plate aluminum. Freezer door
   f. is to also include integral trace heat. All doors are to include vinyl strip curtains and 14" x 14" heated vision window.
   g. Provide all parts and fittings for complete installation and operation in a corrections environment. Also, provide flashing where unit mounts on slab to prevent vermin access.
   h. Units to bear a full factory parts and installation warranty.
   i. System to have (1) year parts warranty on pre-assembled refrigeration systems, (5) year compressor warranty, (10) year warranty on panels.
   j. Alternate manufacturers using the same specifications:

k. ThermoKool AmeriKooler

3. FREEZER REFRIGERATION, to be a 5.5 HP hermetic scroll air cooled refrigeration system set up for operation on 208V-3, -10°F, compressor matched to the respective coil, factory pre-assembled, all controls factory-mounted, electric defrost evaporator coil, (1) year labor warranty on pre-assembled refrigeration systems, (5) year compressor warranty.
   a. Unit to include steel mounting base, galvanized weather housing, winter kit, audio-visual alarm system, time clock, factory mounted controls, all refrigeration piping, parts and fittings for a complete installation.
   b. Alternate manufacturers using the same specifications:
   c. ThermoKool AmeriKooler
4. COOLER REFRIGERATION, to be a 1.0 HP hermetic scroll air cooled refrigeration system set up for operation on 208V-3, 35°F, compressor matched to the respective coil, factory pre-assembled, all controls factory-mounted, electric defrost evaporator coil, (1) year labor warranty on pre-assembled refrigeration systems, (5) year compressor warranty.
5. Unit to include steel mounting base, galvanized weather housing, winter kit, audio-visual alarm system, time clock, factory mounted controls, all refrigeration piping, parts and fittings for a complete installation.
   a. Alternate manufacturers using the same specifications:
   b. ThermoKool AmeriKooler
6. COOLER/FREEEZER SHELVING, to be Metro Super Erecta wire shelving in sizes shown on plan with “Metroseal 3" anti- microbial coating, (4) tiers of Metroseal 3 shelves on (4) 74" SiteSelect posts, plastic split sleeves included, lifetime warranty against rusting, NSF.
   a. NOTE: Food Service Equipment Contactor to Verify size to space allocated.
   b. Alternate manufacturers using the same specifications:
   c. Hodges Nexel
7. FOOD TRANSPORT RACKS, to be Metro model RD3N Mobile Tray Rack, end load, full height, slides on 3" centers with capacity for (20) 18"x26" pans or
   (40) 14"x18" pans, double-riveted aluminum construction, 14-gauge channel bottom frame, 69- ¼" high, four 5" swivel casters (2 with brakes), NSF.
   a. Alternate manufacturers using the same specifications:
   b. Cres Cor John Boos
8. PREPARATION SINKS, to be Advance Regaline model 94-42-48-24RL Spec-Line Two-Compartment Sink, all-welded 14-Gauge 304 stainless steel construction, (2) 24" x 24" bowls with 14" water level, 24" drainboards to right and left, 31" F/B x 101" L/R, K-495 turned down 11" backsplash at rear (enclosed where exposed), all TIG-welded 304 stainless steel construction, stainless steel gussets & channels, 1-⅝" tubular stainless steel legs with welded front-to-rear & adjustable left-to-right cross rails, 1" stainless steel bullet feet.
   a. All bowls are to have Fisher #22306 lever handled rotary wastes complete with 6" chrome-plated tailpiece and overflows, NSF.
   b. Item to include (1) splash mounted Fisher model 13277 Backsplash Faucet on 8" centers, 14" swing spout, lever handles with color coded indexes, ½" connections, CSA, ADA Compliant.
   c. Provide all parts and fittings for a complete installation and proper operation.
   d. Alternate manufacturers using the same specifications:
   e. Custom Fabricated Aero Industries
9. FOOD PROCESOR ON PORTABLE STAND, to be Robot Coupe Model CL50EULTRA, Commercial food processor with the 1-1/2HP motor set up for 110V-21 operation and to include the following attachments:
   a. Vegetable prep attachment with kidney shaped and cylindrical hoppers, 1EA (28058) - 3mm grating disc, 1EA (28064) 3mm slicing disc, 1EA 28004 4mm slicing disc, and 1EA 28112 dicing kit with standard pieces.
   b. Alternate manufacturers using the same specifications:
   c. Waring Hobert

10. 650 POUND ICE MACHINE WITH BIN, to be Manitowoc model IYT-0650A-X Indigo NXT Series Ice Maker set up for operation on 208V-1, 5.9 amps, 22” wide, half-dice, air-cooled, self-contained condenser, production capacity of approximately 460 pounds in 24 hours, acoustic ice sensing probe, programmable ice production, stainless steel exterior with DuraTech clear-coat finish, R410A refrigerant, (3) year parts & labor on machine, (5) year warranty on compressor, (5) year parts & labor warranty on evaporator, cULus, NSF.
    a. Item to include Luminice II ultra-violet bacteria growth inhibitor, AuCS automatic cleaning system and Arctic Pure sanitary quick change water filter assembly located to allow easy access for cartridge replacement.
11. Above to be mounted one model D-420 bin, 22”W x 34"D x 50”H, 383-pound storage capacity, foamed-in-place polyurethane insulation bin & door, top-hinged front-opening door, internal scoop holder, Dura-Tech stainless exterior finish with clear coat, 4” adjustable legs, (3) year parts & labor warranty on bin and accessories, NSF. .
    a. Alternate manufacturers using the same specifications:
    b. Scotsman Hoshizaki
12. WORK TABLES, to be Advance Tabco model TKSS-3010 inch size, shape and configuration as shown in drawing and corresponding detail, 102"W x 30"D, 14-gauge 304 stainless steel top, sound-deadened, 1-⅝" sanitary rolled rim front edge, 5" back splash (see Note), 18-gauge adjustable undershelf, reinforced stainless steel understructure, 1-⅝" 16- gauge stainless steel legs on adjustable 1" stainless steel adjustable bullet
    a. feet, stainless steel gussets, all TIG welded 304 stainless steel construction with exposed weld areas polished to match adjacent surfaces, NSF.
    b. Mounted in lower unit backsplash is to be a 110V-1 receptacle. Provide all parts and fittings necessary for a complete installation.
    c. NOTE: Backsplashes of Items 010 table Tables shall match in height and alignment and be seam-sealed with TA-29 capping strip.
    d. Alternate manufacturers using the same specifications: Custom Fabricated
    e. Aero Industries
        1) FANS AND DUCTWORK, In Division 23, and not in *Division 11 06 40*.
        2) EXHAUST HOOD WITH FIRE SUPPRESSION SYSTEM, In *Division 23*,
    f. and not in *Division 11 06 40*.
13. UTILITY DISPRIBUTION SYSTEM, to be CaptiveAire UDI Utility Distribution System provided in size and shape, and configuration as indicated on drawings and corresponding details. The UDS shall provide gas, electrical, hot & cold-water service as required for the cooking equipment indicated.
    a. System shall have two vertical risers, one on each end, with one dedicated to electrical and the other to plumbing. The risers shall include bumper guards & adjustable riser collars. A circuit-protected dual convenience outlet shall be provided on each riser. The horizontal distribution raceway between the risers shall be separated into electrical and plumbing compartments and each shall be completely enclosed and watertight with removable access panels. The risers and raceway shall be constructed of 16-gauge type 304 stainless steel, #4 finish.
    b. Approvals: Unit(s) shall be ETL Listed to US and Canadian Standards, ETL Sanitation Listed, AGA and MA approved.
    c. Provide emergency shut down for gas/electric, fire/fuel shut off control. Main power connection shall be made to the main circuit breaker which has a shunt trip and is mounted in the electrical riser.
    d. Electrical power shall be fed through a main circuit breaker to a distribution panel which contains individual branch breakers. Each appliance is fed from the individual breakers which are wired to each receptacle located along the raceway. Electrical distribution panel located in the riser shall be equipped with branch circuit breakers and sized for expansion. Electrical outlets and cord sets shall provide moisture resistant covers and have been sized per NEMA standards. Each is supplied with a matching cord and plug set for each appliance. One point disconnect through a main circuit breaker equipped with a 120 VAC rated shunt trip provided in the riser. Gas Solenoid Valves shall be provided with a manual reset button and time delay relay to

prevent pilot lights from going out in momentary power outages.

e. The plumbing compartment shall be completely isolated from the electrical with all piping labeled. Hot and cold water and steam supply and return manifolds shall be insulated. All incoming service connections shall be provided with shut-off valve. Each branch connection shall be provided with shut-off valve, with color coded hoses, and located at each equipment location. Color-coded quick disconnect hoses are provided for connection to equipment.
    1) Remote Status Indicator Panel: Lighted panel indicates status of receptacles in wireway system.
    2) Electric Outlets & Cord Sets: Watertight pin and sleeve outlets and cords.
    3) Hoses, Cords and Plugs
    4) Bumper Strips
    5) Swivel Connectors for gas equipment.
    6) Cold Water Filtration System Fill Faucet: Pre-plumbed and installed faucets, mixing valves, hose reels.
f. Factory Tested Unit(s) shall be operated, tested and set at the factory using job-site conditions for electrical and gas input. All operating and safety controls shall be tested and set at the factory.
g. Service and Parts: The supplier shall furnish gas piping schematics, as built wiring connection and control-circuit diagrams, dimension sheets and a full description of the unit(s). Service manuals showing service and maintenance requirements, shall be provided with each unit.
h. NOTE: Provide all parts and fittings necessary for a complete installation.
    1) See individual units for total gas load.
i. NOTE: Installation must be coordinated with exhaust hood supplier (Div 23).
j. Alternate manufacturers using the same specifications: Greenheck
k. Avtec Industries

14. SKILLET DRAIN TROUGHS, to be Advance FFTG series in size and shape shown on plan and detail drawing with stainless steel trough, FT-1 anti-splash guard and skid resistant fiberglass composite grating.
    a. Alternate manufacturers using the same specifications: Custom Fabricated
    b. Aero Industries
15. 40 GALLON TILTING SKILLETS, to be Vulcan VG40 Braising Pan set up for operation on natural gas and 110V-1 with rear gas connection and electrical cord/plug assembly, 46"W x 35-½"D x 40-½"H wide, open base, on 12” legs (1) 30,000 burner for each 12" pan width (total 120,000), automatic 5° tilt burner shut-off, manual tilt, 9" deep stainless steel pan with embossed gallon markings, full width 4" return flange with formed pouring lip & removable strainer, stainless steel spring
    a. assist cover with drip edge, pan holder, electronic ignition, water-tight solid state temperature controls adjustable from 50°F to 425°F, single filler faucet with 18" double jointed swivel spout, 2" draw-off valve at left side 90° front with strainer, 12" stainless steel legs with adjustable flanged feet, combination gas valve with built-in regulator, ¾" NPT rear gas connection,
        1. year limited parts and labor warranty, CSA Star, CSA Flame, UL EPH.
    a. NOTE: Draw-off valve shall be BPDOV-3 to allow retention of pan support.
    b. Item to include Item to include Dormont 1675NPKIT48 Safety System Stationary Gas Connector Kit, ¾" ID, 48" in length, flexible annealed 304 stainless steel tubing, Connector Kit, 225,000 /hr minimum flow capacity, pressure regulator, limited lifetime warranty, cCSAus, NSF.
    c. NOTE: Verify gas connector kit is correct for equipment. Provide all parts and fittings for a complete installation.
    d. Alternate manufacturers using the same specifications: Cleveland
    e. Groen Industries

2. STEAM COMPARTMENT COOKER, to be Vulcan model C24GA10-BSC Convection Steamer set up for operation on natural gas and 110V-1 with cord and plug, two compartments on 24" cabinet base with capacity of (10) 12" x 20" x 2-½" deep pans total (5 each section), high output stainless steel steam generator with staged water fill, BSC basic manual controls with 60-minute timer with buzzer each compartment, split water line, rear gas and water connections, manual timed SmartDrain and PowerFlush System, ScaleBlocker water filter system, stainless steel interior, exterior, frame & flanged feet, electric ignition, 125,000, ¾" gas connection, gas valve, pressure regulator, ¾" generator water supply,
   a. ¾" condensing water supply, 1-½" NPT drain connection, (1) year parts and labor warranty, additional 12-month K-12 School Nutrition extended warranty.
   b. Item to include:
      - Dormont 1675NPKIT48 stationary gas connector kit, Dormont Stationary Gas Connector Kit, ¾" inside dia., 48" long, coated with yellow antimicrobial PVC, 1 full port valve (2) 90° elbows, NPFS Connector Kit, 225,000 /hr minimum flow capacity, limited lifetime warranty, cCSAus, NSF Component.
      - Dormont W75BP2Q48 Hi-PSI Water Connector Hose Kit(s) for generator and condensing water supply, ¾" diameter, 48" long, covered with stainless steel braid, coated with gray antimicrobial PVC, brass two-way Quick Disconnect coupling, 2-year warranty.
   c. NOTE: Verify gas and water connector kits are correct for equipment. Verify water filter system is correct for equipment.
   d. Provide all parts and fittings for a complete installation.
   e. Alternate manufacturers using the same specifications: Cleveland
   f. Groen Industries
3. DOUBLE DECK CONVECTION OVEN, to be Vulcan model VC66GD set up for operation on natural gas and 110V-1 with (2) 6' cords and NEMA 5-15 plugs, double-deck, bakery depth, solid state controls with timer and audible alarm, electronic spark igniters, 8" high stainless steel legs in lieu of casters, rack hanger, stain natural-plated racks per section, eleven-position nickel plated rack guides with positive rack stops, 50,000 each section (100,000 total), ½ HP 2-speed fan motor, factory stacked and interpiped with single ¾" rear gas connection, (1) year limited parts & labor warranty, NSF, CSA Star, CSA Flame, ENERGY STAR.
   a. Provide video (where available) demonstrating operation, cleaning and maintenance of this equipment.
   b. Item to include Item to include Dormont 1675NPKIT48 Stationary Gas Connector Kit, coated with yellow antimicrobial PVC, (1) full port valve, (2) 90º elbows, NPFS Connector Kit, 225,000 /hr minimum flow capacity, limited lifetime warranty, all parts and fittings for a complete installation.
   c. Alternate manufacturers using the same specifications: Garland
   d. South bend
4. 30 QT FLOOR MIXER, to be Hobart HL300 Legacy Planetary 30 QT Floor Mixer set up for operation on 110V-1 with cord, plug and receptacle, 3/4-HP, (3) fixed speeds plus stir speed, gear-driven transmission, 15-min. SmartTimer, #12 Taper Attachment Hub, metallic gray hybrid powder coat finish, open base, cULus, (1) year parts & labor warranty, cULus, NSF.
   a. Item to include the following accessories and attachments
      - 20-Quart stainless steel bowl
      - "B" flat beater
      - "D" wire whip
5. "ED" dough hook
6. Ingredient chute
   a. Alternate manufacturers using the same specifications: Blakeslee
   b. Univex
7. WORK TABLE, to be Advance Tabco model TKSS-3010 inch size, shape and configuration as shown in drawing and corresponding detail, 120"W x 30"D, 14-gauge 304 stainless steel

top, sound-deadened, 1-⅝" sanitary rolled rim front edge, 5" back splash (see Note), 18-gauge adjustable undershelf, reinforced stainless steel understructure, 1-⅝" 16- gauge stainless steel legs on adjustable 1" stainless steel adjustable bullet

a. feet, stainless steel gussets, all TIG welded 304 stainless steel construction with exposed weld areas polished to match adjacent surfaces, NSF.
b. Mounted in backsplash is to be a 110V-1 receptacle, plus a receptacle for item 027 mixer.
c. Table to have finished rear at location adjacent to item 027 mixer. Provide all parts and fittings necessary for a complete installation.
d. NOTE: Backsplashes of Items 021 table & 022 table shall match in height and alignment, and be seam-sealed with TA-29 capping strip
e. Alternate manufacturers using the same specifications: Custom Fabricated
f. Aero Industries

8. WORK TABLE, to be Advance Tabco model TKSS-307 inch size, shape and configuration as shown in drawing and corresponding detail, 84"W x 30"D, 14-gauge 304 stainless steel top, sound-deadened, 1-
   a. ⅝" sanitary rolled rim front edge, 5" back splash (see Note), 18-gauge adjustable undershelf, reinforced stainless steel understructure, 1-⅝" 16- gauge stainless steel legs on adjustable 1" stainless steel adjustable bullet feet, stainless steel gussets, all TIG welded 304 stainless steel construction with exposed weld areas polished to match adjacent surfaces, NSF.
   b. Mounted in backsplash is to be a 110V-1 receptacle, plus a receptacle for item 027 mixer.
   c. Table to have finished rear at location adjacent to item 027 mixer. Provide all parts and fittings necessary for a complete installation.
   d. NOTE: Backsplashes of Items 022 table & 021 tables shall match in height and alignment, and be seam-sealed with TA-29 capping strip
   e. Alternate manufacturers using the same specifications: Custom Fabricated
   f. Aero Industries
9. SLICER ON PORTABLE STAND, to be Hobart model HS7-1 heavy-duty automatic unit set-up for operation on 110V-1 with 6-foot cord &
   a. NEMA plug, removable 13" Clean-Cut knife with removal tool, (3) stroke lengths, & (4) stroke speeds, removable meat grip assembly, removable ring guard cover, single action top-mounted sharpener with Borazon stones, manual lift lever, ½ hp motor, (1) year parts & labor warranty, cETLus, NSF.

   Item to include one Advance Tabco MT-MS-303 Mobile Mixer Table with Tray Slides, 30"W x 36"L x 28"H, 14-gauge 304 stainless steel no-drip top with galvanized understructure, aluminum pan rack with 2" spacing to accommodate (6) 18" x 26" pans, 1-⅝" diameter stainless steel legs, set of
      1) swivel casters with rubber wheels, (2) with brakes, NSF.
   b. Alternate manufacturers using the same specifications:
   c. Univex Globe
      1) FANS AND DUCTWORK, In Division 23, and not in *Division 11 06 40*.
      2) EXHAUST HOOD WITH FIRE SUPPRESSION SYSTEM, In Division 23, and not in *Division 11 06 40*.
10. UTILITY DISTRIBUTION SYSTEM, to be CaptiveAire UDI Utility Distribution System provided in size and shape, and configuration as indicated on drawings and corresponding detail. The UDS shall provide gas, electrical, hot & cold-water service as required for the cooking equipment indicated.
    a. System shall have two vertical risers, one on each end, with one dedicated to electrical and the other to plumbing. The risers shall include bumper guards & adjustable riser collars. A circuit-protected dual convenience outlet shall be provided on each riser. The horizontal distribution raceway between the risers shall be separated into electrical and plumbing compartments and each shall be completely enclosed and watertight with removable access panels. The risers and raceway shall be constructed of 16-gauge type 304 stainless steel, #4 finish.

b. Approvals: Unit(s) shall be ETL Listed to US and Canadian Standards, ETL Sanitation Listed, AGA and MA approved.
c. Provide emergency shut down for gas/electric, fire/fuel shut off control. Main power connection shall be made to the main circuit breaker which has a shunt trip and is mounted in the electrical riser.
d. Electrical power shall be fed through a main circuit breaker to a distribution panel which contains individual branch breakers. Each appliance is fed from the individual breakers which are wired to each receptacle located along the raceway. Electrical distribution panel located in the riser shall be equipped with branch circuit breakers and sized for expansion. Electrical outlets and cord sets shall provide moisture resistant covers and have been sized per NEMA standards. Each is supplied with a matching cord and plug
e. set for each appliance. One point disconnect through a main circuit breaker equipped with a 120 VAC rated shunt trip provided in the riser. Gas Solenoid Valves shall be provided with a manual reset button and time delay relay to prevent pilot lights from going out in momentary power outages.
f. The plumbing compartment shall be completely isolated from the electrical with all piping labeled. Hot and cold water and steam supply and return manifolds shall be insulated. All incoming service connections shall be provided with shut-off valve. Each branch connection shall be provided with shut-off valve, with color coded hoses, and located at each equipment location. Color-coded quick disconnect hoses are provided for connection to equipment.
    - Remote Status Indicator Panel: Lighted panel indicates status of receptacles in wireway system.
    - Electric Outlets & Cord Sets: Watertight pin and sleeve outlets and cords.
    - Hoses, Cords and Plugs
    - Bumper Strips
    - Swivel Connectors for gas equipment.
g. Cold Water Filtration System Factory Tested
h. Unit(s) shall be operated, tested and set at the factory using job-site conditions for electrical and gas input. All operating and safety controls shall be tested and set at the factory.
i. Service and Parts: The supplier shall furnish gas piping schematics, as built wiring connection and control-circuit diagrams, dimension sheets and a full description of the unit(s). Service manuals showing service and maintenance requirements shall be provided with each unit.
j. NOTE: Provide all parts and fittings necessary for a complete installation.
    - See individual units for total gas load.
k. NOTE: Installation must be coordinated with exhaust hood supplier (Div 23)
l. Alternate manufacturers using the same specifications: Greenheck
m. Avtec Industries

11. STAINLESS STEEL COLUMN CLADDING, required to be custom fabricated from 14 GA stainless steel to clad the columns shown from the tile base up to the finished ceiling. Units to cover walls on all four (4) sides.
    1) SINGLE DECK COMBI OVEN, One required to be Alto-Shaam model
    b. 7-20G PRO, gas fired boiler free combi oven, with 98,000btu natural gas heat source, and 110V-1, controls. Unit to also include a removable “T” style temperature probe, and WIFI enabled controls.
    c. Unit to be capable of holding 7-18”x26” full size sheet pans or 16- 12”x20” full size hotel pans. Unit to also include #5016083 Combi Oven Statiuonary Stand complete with stainless steel shelves.
    d. Unit to be complete with all parts and fittings for a complete installation including the Dormont gas and plumbing connectors for the UDS system.
    e. Alternate manufacturers using the same specifications: Cleveland
    f. Vulcan

12. LANDING TABLE, to be Advance Tabco model KSS-363 inch size, shape and configuration as shown in drawing and corresponding detail, 36"W x 36"D, 14-gauge 304 stainless steel top, sound-deadened, 1-
    a. ⅝" sanitary rolled rim front edge, 10" back splash (see Note), 18-gauge adjustable undershelf, reinforced stainless steel understructure, 1-⅝" 16- gauge stainless steel legs on adjustable 1" stainless steel adjustable bullet feet, stainless steel gussets, all TIG welded 304 stainless steel construction with exposed weld areas polished to match adjacent surfaces, NSF.
    b. Item to include (1) model SHD-2020 Heavy-Duty Drawer with hardware positioned as shown, 20"W x 20"D x 5" depth, stainless steel construction, self-closing, safety-stop tab, removable drawer pan insert, ball bearing slides, NSF.
    c. Alternate manufacturers using the same specifications: Custom Fabricated
    d. Aero Industries
13. OPEN BURNER RANGE, to be Vulcan model V4B36-S Series Heavy Duty Range set up for operation on natural gas, 36"W, (4) 35,000 open burners , cast iron grates, standard oven base, stainless steel front, front top ledge, sides, base, burner box & stub back, 140,000 total, 6" adjustable legs, rear manifold gas connection with , ¾" NPT pressure regulator and reducer, holes for gas lines cut out at factory, item includes 90° elbow and gas pipe, (1) year parts & labor warranty with additional 12-month extended K-12 warranty, CSA, NSF.
    a. Item to include (1) Dormont 16125KIT2S48 Safety System Blue Hose Moveable Gas Connector Kit, 1-¼" inside dia., 48" long covered with
    b. stainless steel braid, coated with blue antimicrobial PVC, (1) SnapFast Quick-Disconnect Valve, (2) Swivel MAX fittings, coiled restraining cable with hardware, gas valve, 1 full port valve, 160,000 /hr minimum flow capacity, limited lifetime warranty, ANSI Z21, UL, CSA, NSF.
    c. Alternate manufacturers using the same specifications: Garland
    d. South Bend
14. SINGLE DECK COMBI OVENS, to be Alto-Shaam model 7-20G PRO, gas fired boiler free combi oven, with 98,000btu natural gas heat source, and 110V-1, controls. Unit to also include a removable “T” style temperature probe, and WIFI enabled controls.
    a. Unit to be capable of holding 7-18”x26” full size sheet pans or 16- 12”x20” full size hotel pans. Unit to also include #5016083 Combi Oven Stationary Stand complete with stainless steel shelves.
    b. Unit to to be complete with all parts and fittings for a complete installation including the Dormont gas and plumbing connectors for the UDS system. .
    c. Alternate manufacturers using the same specifications: Cleveland
    d. Vulcan
15. WORK TABLES, to be Advance Tabco model TKSS-3010 inch size, shape and configuration as shown in drawing and corresponding detail, 102"W x 30"D, 14-gauge 304 stainless steel top, sound-deadened, 1-⅝" sanitary rolled rim front edge, 5" back splash (see Note), 18-gauge adjustable undershelf, reinforced stainless steel understructure, 1-⅝" 16- gauge stainless steel legs on adjustable 1" stainless steel adjustable bullet
    a. feet, stainless steel gussets, all TIG welded 304 stainless steel construction with exposed weld areas polished to match adjacent surfaces, NSF.
    b. Mounted in lower unit backsplash is to be a 110V-1 receptacle. Provide all parts and fittings necessary for a complete installation.
    c. NOTE: Backsplashes of Items 034 tables shall match in height and alignment, and be seam-sealed with TA-29 capping strip.
    d. Alternate manufacturers using the same specifications: Custom Fabricated
    e. Aero Industries
        - FANS AND DUCTWORK, In Division 23, and not in *Division 11 06 40*.
        - EXHAUST HOOD WITH FIRE SUPPRESSION SYSTEM, In Division 23,
    f. and not in *Division 11 06 40*.
16. SET UP TABLE, to be Advance Tabco model TKSS-363 inch size, shape and configuration as shown in drawing and corresponding detail, 36"W x 36"D, 14-gauge 304 stainless steel

top, sound-deadened, 1-
   a. ⅝" sanitary rolled rim front edge, 5" back splash (see Note), 18-gauge adjustable undershelf, reinforced stainless steel understructure, 1-⅝" 16- gauge stainless steel legs on adjustable 1" stainless steel adjustable bullet feet, stainless steel gussets, all TIG welded 304 stainless steel construction with exposed weld areas polished to match adjacent surfaces, NSF.
   b. Alternate manufacturers using the same specifications: Custom Fabricated
   c. Aero Industries
17. CONVEYOR PIZZA OVEN, to be Middleby Marshall model #PS-640-1, gas fired conveyor pizza oven set for natural gas operation with 208V-1, motor and controils.
   Unit to include Dormont style gas connection hose, plusall parts and fittings for a complete installation.
   a. Alternate manufacturers using the same specifications: Lincoln
   b. Volrath
18. STAINLES STEEL WALL FLASHING, required to be custom fabricated from 16 GA stainless steel and be mounted on the wall behind item 038 Pizza oven and extend from tile base to underside of exhaust hood item 036.
19. LANDING TABLE to be Advance Tabco model TKSS-363 inch size, shape and configuration as shown in drawing and corresponding detail, 36"W x 36"D, 14-gauge 304 stainless steel top, sound-deadened, 1-
   a. ⅝" sanitary rolled rim front edge, 5" back splash (see Note), 18-gauge adjustable undershelf, reinforced stainless steel understructure, 1-⅝" 16- gauge stainless steel legs on adjustable 1" stainless steel adjustable bullet feet, stainless steel gussets, all TIG welded 304 stainless steel construction with exposed weld areas polished to match adjacent surfaces, NSF.
   b. Alternate manufacturers using the same specifications: Custom Fabricated
   c. Aero Industries
20. PORTABLE HOT CARTS, required to be Metro C539-HFC-U, portable heated pizza holding carts set up for operation on 110V-1 each unit to include a cord and plug.
   a. Alternate manufacturers using the same specifications: Cres Cor
   b. Vulcan
      • 3-COMPARTMENT SINK UNIT WITH CLEAN DISH TABLE, Lot, to be
   c. custom fabricated from 14 GA stainless steel per attached general specifications. Unit is to be fabricated with a 10” high backsplash with a 2” 45-degree rear turn. Where table is against a wall, the unit is to have a 10" splash with turn down at rear secured to the wall with ' Z ' clips and sealed.
   d. Unit to include three wash tanks that are 26”x 24”x 10” deep, plus an adjacent soak tank 26”x 36”x 10” deep. Each tank is to include a All bowls are to have Fisher 22306 Drain King lever handled rotary wastes complete with overflows. Provide (2) Fisher 5414 ¾" splash mounted swivel faucets on 8" centers with 14" spouts.
   e. Unit is to also include two (2) drainboards as shown with unit to 24” in length with the second drain board to be 36” in length and be fabricated to connect with item #046 pot and pan washer.
   f. Unit is to be mounted on reinforced stainless-steel understructure, 1-⅝" 16- gauge stainless steel legs on adjustable 1" stainless steel adjustable bullet feet, stainless steel gussets.
21. WALL MOUNTED POT RACK, to be Advance model SW-96 inch size and shape as shown on plan and corresponding detail, 96"W x 12"D, double bar design, welded stainless steel construction, secured to wall by means of bolts through welded brackets. Unit flat bar to be constructed of ¼" x 2"satin-finished stainless steel and to include (18) plated double pot hooks.
   a. Alternate manufacturers using the same specifications: Custom Fabricated
   b. Aero Industries
      • FANS AND DUCTWORK, In Division 23, and not in *Division 11 06 40*.

22. CONDENSATE HOOD, to be custom fabricated to size and shape shown on plan. Unit to be constructed from 18-gauge stainless steel
    a. with 6" x 6" duct collar, full length removable baffles, ½" npt drain fitting and all joints welded watertight.
23. DOOR TYPE POT AND PAN WASHER, to be Hobart model AM16 Series Dishwasher set up as shown and for operation on 208V-3, door type, hot water/chemical sanitizing, 58-65 racks/hour, 27" door opening, straight-thru, auto-fill, vent fan control, timed wash cycles, solid- state controls with digital status, electric tank heat, auto-fill, integral booster heater capable of heating 120°F final rinse water to 180°F, interchangeable rinse arms, stainless steel tank/ front panel/frame/doors/legs/feet, single point electrical connection, 5 kW (machine), 5 kW (booster), (1) year parts & labor warranty, cULus, NSF, ENERGY STAR.
    a. Provide all parts and fittings for complete installation and operation.
    b. NOTE: Booster heater requires a separate 208V-3 electrical connection.
    c. Alternate manufacturers using the same specifications: Blakeslee
    d. Champion
24. WASTE SCRAPPING SYSTEM, to be Salvajor Model S914 Scrap Collector set up for operation on 208V-1, pre-flushing and food waste collecting system with recirculating water, all stainless steel construction, pre-wired NEMA 4 control panel, 24-volt circuitry, HydroLogic control panel, safety line disconnect, salvage basin & silverware trap, (1) scrap basket, ¾- HP corrosion-resistant pump, pump intake screen, water diffuser, ¾" hot & cold water supply (reduced to ½" at connection), 2" tank drain (piping not included), requires 24" min. dish rack space, UL, CSA, CE, NSF.
    a. Provide recirculation plumbing (recirculation piping requires 6" additional space from back of trough to wall), rubber gusher heads/nozzles.
    b. Provide (1) Fisher model 13390 Pre-Rinse Unit, spring style, backsplash mount, 8" centers, 21" riser, 36" 3-ply fiber-reinforced internal rubber hose with stainless steel external jacket & end fittings, 1.15 GPM Ultra-Spray PLUS spray valve with built-in spray handle clip & dish guard bumper, lever handles with color coded indexes, internal spring-loaded check valves, stainless steel seats/seat screws/handle screws, includes wall bracket, ½" NPT male inlets, brass, ADA Compliant.
    c. Item to include elbows, supply lines and all other parts and fittings for a complete installation.
        - Note: Item to be installed into Item 090 Dish Table as shown in drawing and corresponding detail. Allow minimum 24" clearance between collector and dish machine.
        - Note: Collector top to be shipped to fabricator for welding into dish table as shown, minimum of 24" clearance required between collector and dish machine.
    d. Alternate manufacturers using the same specifications: No alternate manufacturer
25. SOILED DISH TABLE, Lot, to be custom fabricated per specifications to size and shape shown on plan and corresponding detail, unit to have 14-gauge stainless steel top with shelf extension mounted on 1-⅝" diameter legs and welded crossrails with stainless steel adjustable bullet feet. Table top to have cut-out to accommodate Item 049 Waste Collector System Top. Where table is against a wall, the unit is to have a 10" splash with turn down at rear secured to the wall with ' Z ' clips and sealed.
26. CLEAN SERVICE WARE STORAGE SHELVES, to be to be Metro Super Erecta wire shelving in sizes shown on plan with “Metroseal 3" anti-microbial coating, (4) tiers of Metroseal 3 shelves on (4) 74" SiteSelect posts, plastic split sleeves included, lifetime warranty against rusting, NSF.
    a. NOTE: Verify size to space allocated.
    b. Alternate manufacturers using the same specifications: Hodges
    c. Nexel
27. PIZZA SERVING COUNTER, to be custom fabricated to size and shape shown on plan and be designed to protrude through the designated opening and have from turned down to cover and match tray slide. The unit is to be mounted on 1-5/8” stainless steel legs on adjustable 1” diameter bullet feet. The unit is to include 18 GA stainless steel adjustable

under-shelves and include cut outs for items #056-drop in cold pan, #057-drop in pizza warming shelf, and a cut out and lower shelf for item #086-beverage display case.
   a. The lower support shelf is to be fabricated to hold the beverage refrigerator to a height that allows the front of the unit to match the base counter height.
   b. On end of unit as shown is to be a cashier's station with end mounted cash drawer, plus a 2" diameter ferruled hole for the register power cable.
28. DROP IN COLD PAN, to be Atlas Set-N-Serve model WCM- 1, self-contained refrigerated cold pan with the capacity of one (1) standard restaurant pan and be approximately 4-5/8" deep.
   a. Unit to include hermetically sealed compressor, thermostat control, on and off switch, condensate drain, cord and plug..
   b. Alternate manufacturers using the same specifications: Delfield
   c. Randell
29. DROP IN PIZZA WARMING TRAY, to be Hatco model HBGBHC-4818, heated black glass drop shelf set up for 208V-1 operation and to include control box which is to be mounted on rear apron of #055 pizza counter.
   a. Alternate manufacturers using the same specifications: No alternate manufacturer
30. PROTECTOR CASE, to be Atlas Set-N-Serve model #5 full-service protector case complete with a 36" heat lamp #059 and the balance to be illuminated with fluorescent light fixture.
   a. Alternate manufacturers using the same specifications: Delfield
   b. Randell
31. HEAT LAMP, to be Hatco model GM5AH-36, set up for operation on 208V-1, complete with cord and plug.
   a. Alternate manufacturers using the same specifications: Alternate units for this can be alternate manufacturer's heat lamp.
32. FRONT TRAY SLIDE, to be custom fabricated to size and shape shown on plan and be mounted on low wall at Pizza Line. Unit to have a rear up turn fabricated to match with the downturn of the counter #055 to create a seem-less joint between the two pieces.
33. HOT SANDWICH LINE COUNTER, to be custom fabricated to size and shape shown on plan and be designed to protrude through the designated opening and have from turned down to cover and match tray slide. The unit is to be mounted on 1-5/8" stainless steel legs on adjustable 1" diameter bullet feet. The unit is to include 18 GA stainless steel adjustable under-shelves and include cut outs for items #063-drop in cold
   a. pan, #064-drop in hot wells, and a cut out and lower shelf for item #086- beverage display case. On the rear of the counter behind the hot and cold wells, is to a 10" deep plating shelf as shown.
   b. The lower support shelf is to be fabricated to hold the beverage refrigerator to a height that allows the front of the unit to match the base counter height.
   c. On end of unit as shown is to be a cashier's station with end mounted cash drawer, plus a 2" diameter ferruled hole for the register power cable.
34. DROP IN COLD PAN, to be Atlas Set-N-Serve model WCM- 2, self-contained refrigerated cold pan with the capacity of two (2) standard restaurant pan and be approximately 4-5/8" deep.
   a. Unit to include hermetically sealed compressor, thermostat control, on and off switch, condensate drain, cord and plug.
   b. Alternate manufacturers using the same specifications: Delfield
   c. Randell
35. DROP IN HOT WELLS, to be Atlas Set-N-Serve WIH-3, electrically heated 3 hot food well unit set up for 208V-1 operation, and to include individual controls and DME drain and front (operator side) manifold with shut off valve. Unit to also include (1) Fisher model 3010 deck-mounted single pantry faucet, 6" swing spout, ½" inlet, mounted on Item #062, counter in positioned as shown.
   a. Delfield Randell
36. PROTECTOR CASE, to be Atlas Set-N-Serve model #5 full-service protector case complete with a 36" heat lamp #066 and the balance to be illuminated with fluorescent light

fixture.
   a. Alternate manufacturers using the same specifications: Delfield
   b. Randell
37. FRONT TRAY SLIDE, to be custom fabricated to size and shape shown on plan and be mounted on low wall at Hot Sandwich Line. Unit to have a rear up turn fabricated to match with the downturn of the counter #062 to create a seem-less joint between the two pieces.
38. ENTRÉE LINE SERVING COUNTER, to be custom fabricated to size and shape shown on plan and be designed to protrude through the designated opening and have from turned down to cover and match tray slide. The unit is to be mounted on 1-5/8" stainless steel legs on adjustable 1" diameter bullet feet. The unit is to include 18 GA stainless steel adjustable under-shelves and include cut outs for items #070-drop in cold pan, #072-drop in hot wells, and a cut out and lower shelf for item #086-beverage display case. On the rear of the counter separately behind the hot and cold wells, are to a 10" deep plating shelves as shown.
   a. The lower support shelf is to be fabricated to hold the beverage refrigerator to a height that allows the front of the unit to match the base counter height.
   b. On end of unit as shown is to be a cashier's station with end mounted cash drawer, plus a 2" diameter ferruled hole for the register power cable.
39. DROP IN COLD PAN, to be Atlas Set-N-Serve model WCM- 3, self-contained refrigerated cold pan with the capacity of two (2) standard restaurant pan and be approximately 4-5/8" deep.
   a. Unit to include hermetically sealed compressor, thermostat control, on and off switch, condensate drain, cord and plug.
   b. Alternate manufacturers using the same specifications: Delfield
   c. Randell
40. PROTECTOR CASE, to be Atlas Set-N-Serve model #3 full-service protector case complete with fluorescent light fixture.
   a. Alternate manufacturers using the same specifications: Delfield
   b. Randell
41. DROP IN HOT WELLS, to be Atlas Set-N-Serve WIH-5, electrically heated 5 hot food well unit set up for 208V-1 operation, and to include individual controls and DME drain and front (operator side) manifold with shut off valve. Unit to also include (1) Fisher model 3010 deck-mounted single pantry faucet, 6" swing
spout, ½" inlet, mounted on Item
   a. #069, counter in positioned as shown. Unit to also include an integral cord and plug.
   b. Alternate manufacturers using the same specifications: Delfield
   c. Randell
42. PROTECTOR CASE, to be Atlas Set-N-Serve model #5 full-service protector case complete with a 72" heat lamp #074 and the balance to be illuminated with fluorescent light fixture.
   a. Alternate manufacturers using the same specifications: Delfield
   b. Randell
43. HEAT LAMP, to be Hatco model GM5AH-66, set up for operation on 208V-1, complete with cord and plug.
   a. Alternate manufacturers using the same specifications: Alternate units for this can be alternate manufacturer's heat lamp.
44. FRONT TRAY SLIDE, to be custom fabricated to size and shape shown on plan and be mounted on low wall at Serving Line. Unit to have a rear up turn fabricated to match with the downturn of the counter #069 to create a seem-less joint between the two pieces.
45. SALAD-SANDWICH COUNTER, to be custom fabricated to size and shape shown on plan and be designed to protrude through the designated opening and have from turned down to cover and match tray slide. The unit is to be mounted on 1-5/8" stainless steel legs on adjustable 1" diameter bullet feet. The unit is to include 18 GA stainless steel adjustable undershelves. The unit is to also include a cut out for and lower shelf for item #077-Deli Display Case.
   a. The lower support shelf is to be fabricated to hold the Deli Display Case to a height that

allows the front of the unit to match the base counter height.
   b. On end of unit as shown is to be a cashier's station with end mounted cash drawer, plus a 2" diameter ferruled hole for the register power cable.
46. DELI DISPLAY CASE, to be Structural Concepts model B6624, self-contained refrigerated DELI DISPLAY CASE SET UP FOR 208V-1. Unit to be constructed to allow the mounting on a shelf on item #076 Salad Sandwich counter, and to include following options:
   a. Stainless steel exterior finish, Stainless Steel lower front panel, glass cut- away stainless-steel end panels, lockable rear loading doors, 5 ea LED
   b. lighted metal powder coated white shelves, Breeze-E self-contained refrigeration, clean sweep – coil cleaner, and retractable non locking night curtain. Unit to also include all parts and fittings for a complete unit. .
   c. Alternate manufacturers using the same specifications: Traulsen
   d. Continental
47. FRONT TRAY SLIDE, to be custom fabricated to size and shape shown on plan and be mounted on low wall at Serving Line. Unit to have a rear up turn fabricated to match with the downturn of the counter #076 to create a seem-less joint between the two pieces.
48. DELI REFRIGERATOR, to be Victory RS-1D-S1-HC, self - contained refrigerated unit set up for 110V-1 operation, with exterior and interior stainless-steel finish, hinged as shown, stay open door feature, magnetic doors with that automatically activated interior light, one piece snap magnetic door gasket, silver freeze wire shelves, and cord with plug.
   a. Unit to be mounted on 6" high adjustable stainless-steel legs.
   b. Alternate manufacturers using the same specifications: Traulsen
   c. Continental
49. TRAY DISPENSER CARTS, to be Cambro model #TDC2029 mobile tray cart. Unit to be single molded, seamless, double walled, high density polyethylene and foam injected polyurethane. Unit to be mounted on four (4) 6" diameter swivel casters, two (2) with brakes.
   a. Units to also include vinyl covers for transporting.
   b. Alternate manufacturers using the same specifications: Lakeside
   c. Vollrath
50. TWO SECTION REFRIGERATOR, to be Victory model RS- 2D-S1-HC, solid door reach in refrigerator set up for 110v-1 operation and to include a cord and plug.
   a. Unit to also include stainless steel interior and exterior finishes, stay open doors hinged as shown, magnetic door switch that automatically activates the interior light, heavy duty cylinder locks, one piece snap on magnetic door gasket, 6EA silver freeze wire shelves, and be mounted on 6" high stainless-steel legs adjustable with bullet feet. . .
   b. Alternate manufacturers using the same specifications: Traulsen
   c. Continental
51. PASS THROUGH HEATED CABINET, to be Victory model #HS-2D-1-PT, ultraspec unit set up for operation on 208V-1 and include a cord and plug. Unit to have foamed in place insulation, safety strip heating elements, built-in adjustable humidity control vent, and Santropene one-piece magnetic door gaskets. Self-closing doors to be capable of holding open at 120 degrees.
   a. Unit to have stainless steel interior and exterior, adjustable universal pan slides allowing 6" spacing between slides, camlock hinges, and include glass door on kitchen side of unit.
   b. Unit to be mounted on 6" stainless steel adjustable feet.
   c. Alternate manufacturers using the same specifications: Traulsen
   d. Continental
52. THROUGH REFRIGERATOR, to be Victory model #RS-2D-S1-PC, Ultraspec unit set up for 110V-1 operation and to include a cord and plug.
   a. Unit to have a stainless-steel interior and exterior and include a stay open door feature. The refrigerator is to include adjustable universal pan slides allowing 6" spacing between slides, cam-lock hinges, and include glass door on kitchen side of unit.

b. Alternate manufacturers using the same specifications: Traulsen
c. Continental

53. THROUGH HEATED CABINET, to be Victory model #HS-2D-1-PT, ultraspec unit set up for operation on 208V-1 and include a cord and plug. Unit to have foamed in place insulation, safety strip heating elements, built-in adjustable humidity control vent, and Santropene one-piece magnetic door gaskets. Self-closing doors to be capable of holding open at 120 degrees.
    a. Unit to have stainless steel interior and exterior, adjustable universal pan slides allowing 6” spacing between slides, camlock hinges, and include glass door on kitchen side of unit.
    b. Unit to be mounted on 6” stainless steel adjustable feet. .
    c. Alternate manufacturers using the same specifications: Traulsen
    d. Continental
54. PASS THROUGH REFRIGERATOR, to be Victory model #RS-2D-S1-PC, Ultraspec unit set up for 110V-1 operation and to include a cord and plug.
    Unit to have a stainless-steel interior and exterior and include a stay open door feature. The refrigerator is to include adjustable universal pan slides allowing 6” spacing between slides, cam-lock hinges, and include glass door on kitchen side of unit.
    a. Alternate manufacturers using the same specifications: Traulsen
    b. Continental
55. BEVERAGE DISPLAY CASES, to be Structural Concepts model B3424, self-contained refrigerated display case set up for 110V-1. Unit to be constructed to allow the mounting on a shelf on items #055 pizza counter, item #062 hot sandwich counter, item #069 serving line, and to include following options:
    a. Stainless steel exterior finish, Stainless Steel lower front panel, glass cut- away stainless steel end panels, lockable rear loading doors, 5 ea LED lighted metal powder coated white shelves, Breeze-E self-contained refrigeration, clean sweep – coil cleaner, and retractable non locking night curtain. Unit to also include all parts and fittings for a complete installation.
    b. Alternate manufacturers using the same specifications: Traulsen
    c. Continental
56. CASH REGISTERS, to be provided by operator and not in *Division 11 06 40*.
57. SNACK AND MISCELLANEOUS COUNTER, to be custom manufactured by Randell to size and shape shown on plan. Unit to have top fabricated from 14 GA stainless steel and have all other exposed surfaces clad in a laminate which will be chosen by the client.
    a. The lower support shelf is to be fabricated to hold the refrigerated snack display case #089, to a height that allows the front of the unit to match the base counter height. On ends of unit as shown are to be cashier’s stations
    b. with inside mounted cash drawers, plus 2” diameter ferruled hole for the register power cable.
    c. Alternate manufacturers using the same specifications: Delfield
    d. Duke
58. REFRIGERATED SNACK DISPLAY, to be Structural Concepts model B4424, self-contained refrigerated snack display set up for 208V-1. Unit to be constructed to allow the mounting on a shelf on item #076 Salad Sandwich counter, and to include following options:
    a. Stainless steel exterior finish, Stainless Steel lower front panel, glass cut- away stainless-steel end panels, lockable rear loading doors, 5 ea LED lighted metal powder coated white shelves, Breeze-E self-contained refrigeration, clean sweep – coil cleaner, and removable solid security door. Unit to also includes all parts and fittings for a complete unit.
    b. Alternate manufacturers using the same specifications: Traulsen
    c. Continental
59. DOMESTIC WASHING MACHINE, to be General Electric model GTW680BSJWS Electric Top Load Washer set up for operation on 110V-1 with cord and NEMA plug, 4.6 cu. ft., stainless steel tub, deep fill, speed wash, 14 wash cycles, high-efficiency diffuser wash

system, warm water rinse, electronic controls, automatic water level adjustment, delay start feature, white enamel finish, UL.
   a. Alternate manufacturers using the same specifications:
   b. Sears
   c. LG Manufacturing

60. DOMESTIC DRYER, to be General Electric model GTD65EBSJWS Electric Front Load Dryer set up for operation on 208V-1 with cord and NEMA plug, 7.4 cu. ft. capacity, 4 heat selections, 12 drying cycles, aluminized alloy drum, electronic control panel, dual thermistor moisture sensor to prevent overheating, end of cycle signal, reversible door, lint filter, white enamel finish, UL.
   a. Alternate manufacturers using the same specifications:
   b. Sears
   c. LG Manufacturing
61. 3-COMPARTMENT SINK UNIT, to be Advance model FS-3-1818-18RL, pot and pan sink, to include swivel faucet, 3EA K5 lever wastes with K-4 support brackets.
   a. Alternate manufacturers using the same specifications: Custom Fabricated
   b. Aero Industries
62. STORAGE REFRIGERATOR, to be provided by operator, not in *Division 11 06 40*
      1) STORAGE SHELVING, to be provided by operator, not in *Division 11 06 40*.
         STORAGE RACK, to be provided by operator, not in *Division 11 06 40*.
63. 420 POUND ICE MACHINE WITH BIN, to be Manitowoc model iTO-0420A-X Indigo NXT Series Ice Maker set up for operation on 110V-1, 11.3 amps, 22” wide, half-dice, air-cooled, self-contained condenser, production capacity of approximately 460 pounds in 24 hours, acoustic ice sensing probe, programmable ice production, stainless steel exterior with DuraTech clear-coat finish, R410A refrigerant, (3) year parts & labor on machine, (5) year warranty on compressor, (5) year parts & labor warranty on evaporator, cULus, NSF.
   a. Item to include Luminice II ultra-violet bacteria growth inhibitor, AuCS automatic cleaning system and Arctic Pure sanitary quick change water filter assembly located to allow easy access for cartridge replacement.
   b. Above to be mounted one model D-320 bin, 22”W x 34"D x 59.5”H,
   c. 383-pound storage capacity, foamed-in-place polyurethane insulation bin & door, top-hinged front-opening door, internal scoop holder, Dura-Tech stainless exterior finish with clear coat, 4” adjustable legs, (3) year parts & labor warranty on bin and accessories, NSF. .
   d. Alternate manufacturers using the same specifications:
   e. Scotsman Hoshizaki
64. CONECESSIONS BEVERAGE COUNTER, to be Advance Tabco model EK-SS-3012, cabinet based beverage unit, complete with integral with 14”x16”x12” deep sink with faucet.
   a. The cabinet is to be fabricated from 14 GA stainless steel and to include 18GA stainless steel shelves.
   b. Unit to be mounted on 6” stainless steel adjustable legs.
   c. COFFEE BREWER, to be provided by operator, not in *Division 11 06 40*.
   d. COFFEE WARMERS, to be provided by operator, not in *Division 11 06 40*.
   e. NACHO HOLDING CABINET, to be provided by operator, not in *Division 11 06 40*.
65. NACHO CHEEZE DISPENSER, to be provided by operator, not in *Division 11 06 40*.
      • BUTTER DISPENSER, to be provided by operator, not in *Division 11 06 40*.
        POP CORN MAKER, to be provided by operator, not in *Division 11 06 40*.
        SERVING REFRIGERATOR, to be provided by operator, not in *Division 11 06 40*.
66. 420 POUND ICE MACHINE WITH BIN, to be Manitowoc model iTO-0420A-X Indigo NXT Series Ice Maker set up for operation on 110V-1, 11.3 amps, 22” wide, half-dice, air-cooled, self-contained
   a. condenser, production capacity of approximately 460 pounds in 24 hours, acoustic ice sensing probe, programmable ice production, stainless steel exterior with DuraTech clear-coat finish, R410A refrigerant, (3) year parts & labor on machine, (5) year warranty on compressor, (5) year parts & labor warranty on evaporator, cULus, NSF.

b. Item to include Luminice II ultra-violet bacteria growth inhibitor, AuCS automatic cleaning system and Arctic Pure sanitary quick change water filter assembly located to allow easy access for cartridge replacement.
c. Above to be mounted one model D-320 bin, 22”W x 34"D x 59.5”H,
d. 383-pound storage capacity, foamed-in-place polyurethane insulation bin & door, top-hinged front-opening door, internal scoop holder, Dura-Tech stainless exterior finish with clear coat, 4” adjustable legs, (3) year parts & labor warranty on bin and accessories, NSF.
e. Alternate manufacturers using the same specifications:
f. Scotsman Hoshizaki

67. 3-COMPARTMENT SINK UNIT, to be Advance model FS-3-1818-18RL, pot and pan sink, to include swivel faucet, 3EA K5 lever wastes with K-4 support brackets.
    a. Alternate manufacturers using the same specifications: Custom Fabricated
    b. Aero Industries
68. CONCESSIONS BEVERAGE CABINET, to be Advance Tabco model EK-SS-3012, cabinet-based beverage unit, complete with integral with 14”x16”x12” deep sink with faucet.
    a. The cabinet is to be fabricated from 14 GA stainless steel and to include 18GA stainless steel shelves.
    b. Unit to be mounted on 6” stainless steel adjustable legs.
        - POP CORN MAKER, to be provided by operator, not in *Division 11 06 40*.
        - BUTTER DISPENSER, to be provided by operator, not in *Division 11 06 40*.
          NACHO CHEEZE DISPENSER, to be provided by operator, not in *Division 11 06 40*.
69. NACHO HOLDING CABINET, to be provided by operator, not in *Division 11 06 40*.
70. CONCESSIONS SERVING COUNTER, custom fabricated to size and shape shown on plan and corresponding detail. The unit’s top is to be fabricated from 14 GA stainless steel, and be mounted on 1-5/8” stainless steel legs with adjustable bullet feet. The frame is also to be fabricated from 1-5/8” stainless steel.
    a. The table is to protrude over the concessions opening to provide a seamless surface at the opening to the concessions.
71. CONCESIOSN BEVERAGE CABINET, Advance Tabco model EK-SS-3012, cabinet based beverage unit, complete with integral with 14”x16”x12” deep sink with faucet.
    a. The cabinet is to be fabricated from 14 GA stainless steel, and to include 18GA stainless steel shelves.
    b. Unit to be mounted on 6” stainless steel adjustable legs.
        - COFFEE BREWER, to be provided by operator, not in *Division 11 06 40*.
          COFFEE WARMER, to be provided by operator, not in *Division 11 06 40*.
          POP CORN MAKER, to be provided by operator, not in *Division 11 06 40*.
          BUTTER DISPENSER, to be provided by operator, not in *Division 11 06 40*.
    c. Alternate manufacturers using the same specifications: Custom Fabricated
    d. Aero Industries
72. LAUNDRY SOAK SINK, to be E.L. Mustee model 26F, two compartment laundry one piece molded utility tub mounted on heavy duty steel legs and include twin drain wastes, and a hot and cold faucet.
    a. Alternate manufacturers using the same specifications: Advance Tabco
    b. Aero Industries
73. 60 POUND WASHER EXTRACTOR, to be Milnor 30022 VRJ, self-contained washer extractor set up for 208V-3 operations and to include the following features:
    a. Rinse-Save water saving technology, 7-speed controls include overnight wash and dwell feature that allows for long washing cycles after games.
    b. Unit to also include single motor inverter drive, tall lifting ribs, tapered roller bearing, large cylinder perforations, auto tension drive belt, six (6) liquid chemical injector ports and a five (5) year limited warranty on frame, cylinder and shell.
    c. Unit to include all parts and fittings for a complete installation.
    d. Alternate manufacturers using the same specifications: Braun
    e. Continental Girbau

- IN TROUGH LINT SCREEN, to be custom fabricated from stainless steel per size and shape sown on drawing FS-302.

74. PORTABLE FOLDING TABLE, to be Advance Tabco KSS- 245, 14 GA stainless steel work table with 18 GA stainless steel undershelf.
    a. Unit to be mounted on stainless steel legs with 6" diameter locking casters.
    b. Alternate manufacturers using the same specifications:
    c. Custom Fabricated Aero Industries
75. 80 POUND GAS DRYER, to be M-80-P gas fired dryer set up for operation on natural gas and 208V-3 operation.
    a. Unit to include variable drum speed, pre-heat system, trans axial air flow, fully insulated cabinet, double pane glass doors, fully integrated fire suppression system, direct spark ignition, two (2) point roller support, stainless steel basket and front.
    b. Unit to include all parts and fittings for a complete installation.
    c. Note: All ductwork including discharge vents to be provided in Division 23.
    d. Alternate manufacturers using the same specifications: Braun
    e. Continental Girbau
76. DRYER LINT COLLECTOR, One required to be Energenics model AF-2 (FM), Interior flat mount lint collector. Unit to be designed to support up to 2,000 cfm of exhaust from up to 2-ea 80 pound dryers.
    a. Unit to also include optional cold water fire suppression connection and all parts and fittings for a complete installation.
    b. Note: All ductwork include discharge vent to be provided in Division 23.
    c. Alternate manufacturers using the same specifications: No Alternate
        - ITEM 150 BULK LAUNDRY CARTS, Four (4) required to be Fibertech UC-12,
    d. 15 cu/ft laundry carts with standard galvanized bases and 4" hard rubber casters. .
    e. Alternate manufacturers using the same specifications: No Alternate
77. DRAIN TROUGH one required to HM free standing trough, 36"Wx12"Dx 12"H, unit to be located to accommodate the waste from item #152, washer extractor. Unit to also include built-in lint filter, side washer drain connection, and side unit drain.
    a. Verify with washer extractor manufacturer for size of trough.
    b. Alternate manufacturers using the same specifications: No Alternate

DIVISION 11 13 13 – LOADING DOCK BUMPERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Loading dock bumpers of reinforced rubber pads with attachment frame.

1.02 RELATED REQUIREMENTS

A. *Division 03 10 00* - Concrete Forming and Accessories: Placement of loading dock bumper frame anchors into concrete.
B. *Division 03 30 00* - Cast-In-Place Concrete.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Submit data on unit dimensions, method of anchorage, and details of construction.
C. Manufacturer's Installation Instructions: Submit installation requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Loading Dock Bumpers:
    1. Basis of Design: Blue Giant Equipment Corporation: www.bluegiant.com.
    2. Chalfant Sewing Fabricators, Inc: www.chalfantusa.com.
    3. Durable Corp: www.durablecorp.com.
    4. Approved Equal.
    5. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 COMPONENTS

A. Loading Dock Bumpers: Fabric reinforced rubber pads, ozone resistant, laminated and compressed in position using two galvanized steel rods with threaded ends, washers, and nuts between 3 inches high by 2-1/2 inch wide by 1/4-inch-thick galvanized steel angle end plates.

1. Projection From Wall: 4-1/2 inches.
2. Vertical Height: 10 inches.
3. Width: 15 inches.
4. Profile: Rectangular.
5. Location: Provide 2 bumpers at each bay of trailer loading dock areas. Mount at height and spacing as recommended by bumper manufacturers.

B. Attachment Hardware: 3/4 inches diameter galvanized bolts with expansion shields.
C. Touch-up Primer: Zinc rich type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that anchor placement is acceptable.

3.02 INSTALLATION

A. Install dock bumpers in accordance with manufacturer's instructions.
B. Set plumb and level.
C. Secure angled end frames to concrete. *03 10 00*
D. Weld angled end frames to steel dock frame and touch up welds with primer.
E. Installer shall examine areas and conditions surrounding the work for compliance with requirements for proper installation and performance of equipment. Report all non-compliant conditions to Contractor. Do not begin installation until unsatisfactory conditions have been corrected.
F. Leave work area and surrounding surfaces clean and in good repair. Remedy any damage caused to surrounding work.

DIVISION 11 13 19 – VEHICLE RESTRAINTS

PART 1 – GENERAL

1.01 SUMMARY

A. Related Documents: Provisions established within General and Supplementary Conditions of the Contract, Division 1 - General Requirements and Drawings are collectively applicable to this Section. Section includes, though is not specifically limited to, providing vehicle restraints at all docks provided with dock levelers.
B. Related Sections:
1. *Division 03 30 00* - Cast-In-Place Concrete: Concrete pit.
2. *Division 05 50 00* - Metal Fabrications: Dock slab and door protection edge angles.

1.02 SYSTEM DESCRIPTION

A. Design Requirements: Provide fixed-in-place adjustable vehicle restraint devices.
B. Provide equipment, which has been manufactured, fabricated, and installed to withstand loads specified and to maintain performance criteria stated by manufacturer without defects or failure.
C. Comply with ANSI MH 30.3.

1.03 SUBMITTALS

A. General: Submit in accordance with *Division 01 30 00*.
B. Product Data: Submit product data for vehicle restraint equipment.
C. Shop Drawings: Submit drawings indicating fabrication and erection of restraint equipment, including plans, elevations and large-scale details.
1. Show anchorages, critical installation clearances, connections, and accessory items.
2. Provide location template drawings for items supported or anchored to permanent construction.
3. Provide rough-in drawings for electrical service in advance of concrete work.
D. Informational Submittals: Submit following:
1. Manufacturer's instructions.
E. Closeout Submittals: Submit following in accordance with *Division 01 78 00*.
1. Maintenance data.
2. Warranty: Specified warranty.

1.04 QUALITY ASSURANCE

A. Single source responsibility: Each component of restraint device is required to be from same manufacturer.
B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this

Section with minimum ten years documented experience.

C. Installer Qualifications: Approved in writing by manufacturer with documented experience on at least five projects of similar nature in past five years.

D. Regulatory Requirements: In compliance with ANSI MH 30.3 plus applicable OSHA requirements.

E. Manufacturer to hold current ISO 9002 certification.

1.05 WARRANTY

A. Limited 1-Year Parts & Labor Warranty

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. 4Front Engineered Solutions - KELLEY, 1612 Hutton Drive, Suite 140, Carrollton, Texas, (972) 466-0707 voice, (972) 323-2661 facsimile.
2. Substitutions: *01 60 00* – Product Requirements.

2.02 VEHICLE RESTRAINT DEVICES

A. General: Provide manufacturer's standard mechanical device designed to engage trailer's rear-impact guard and hold truck at loading dock. Mounting frame:3/8" thick heavy structural plate. 1/4" thick steel horizontal mounting plate. Cast ductile iron restraining arm with 45,000 PSI yield strength. T-rail welded to mounting plate with 60" of continuous 3/16" bevel weld. Heavy duty gas spring provides "float" to assure constant contact with rear impact guard. Standard zing plate finish. Push bar: 1 ½" x ½" x 66 ¼" zinc plated tubular steel.

B. Operation: Vehicle restraint designed to hook the rear impact guard of a truck and hold the truck at the loading dock. The restraint is activated using push bar to trigger the latching lever and activate the restraining arm, which will move vertically along the reinforced T-rail until it contacts the vehicle's rear impact guard. When loading/unloading is complete, the operator uses the push bar to return the restraining arm to its stored position.

C. Operating Range: Restraint will engage a rear impact guard positioned 0" to 10" horizontally from the face of a 4" bumper. Vertical hooking range of 11" – 27 ½". Complies with NHTSA regulations for rear impact guards. Unit stores 9 ½" above grade to accommodate low trailers.

D. Mounting: Provide manufacturer's standard mounting method as follows:

1. Provide manufacturer's standard concrete anchor bolts and pit mounted reinforcing plate for field mounting to concrete dock face and pit floor.
2. New Construction Mounting Plate: Designed to be poured in place into dock face with studs for field bolting of restraint back plate, to be used in place of concrete anchor bolds in dock face.

E. Restraining Capacity: Not less than 32,000 lbs.

F. Communication System: Provide manufacturer's standard system, as follows:

1. Exterior Caution Sign: Single surface-mounted sign with forward facing and reversed letters.
2. Interior Instruction Placard: Single surface-mounted placard with operating instructions for the operator.

G. Acceptable Product: Model no.

1. 4Front Engineered Solutions - KELLEY STAR 1.

2.03 FINISHES

A. Finish:

1. Preparation: Clean surfaces free from slag and splatter, loose mill scale, oil, grease, or rust.
2. Factory apply manufacturer's standard zinc-plated finish.
3. Color: Manufacturer's standard color.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions and proceed with Work in accordance with *Division 01 40 00*.

3.02 INSTALLATION

A. Install in accordance with *Division 01 60 00*.

B. Install push bar mounting bracket in accordance with manufacturer's installation instructions.

C. Mount caution sign and operating instructions in accordance with manufacturer's installation instructions.

3.03 ADJUSTING AND CLEANING

A. Adjust installed unit for smooth, safe, efficient and balanced operation.
B. Remove temporary labels and coverings and protection of adjacent work areas.
C. Repair or replace damaged products.
D. Remove construction debris from site and dispose.

3.04 INSTRUCTION OF OWNER'S PERSONNEL

A. Instruct owner's personnel in operation and maintenance of installed units. Provide bound copy of manufacturer's operation and maintenance manual at time of instruction.

DIVISION 11 52 13 – PROJECTION SCREENS

PART 1 - GENERAL

1.01 REFERENCE STANDARDS

A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SUMMARY

A. Section Includes:
   1. Type A: Wall Mounted , permanently tensioned, electric operation projection screens with 137" diagonal viewing area (16:10 aspect ratio image size).
   2. Type B: Wall Mounted , permanently tensioned, electric operation projection screens with 255" diagonal viewing area (16:10 aspect ratio image size).
   3. Type C: Ceiling Mounted , permanently tensioned, electric operation projection screens with 137" diagonal viewing area (16:10 aspect ratio image size).
   4. All electronic screens shall be equipped with 24 volt wall mounted remote three-position control switch (Draper LVC-S or approved comparable product) with cover and plate located adjacent to the projection screen, along with RS-232 low voltage interface (Draper LVC-IV or approved comparable product) to audiovisual remote control systems.

1.04 RELATED SECTIONS

A. Division 05 Section, "Metal Fabrications," for support and hanging systems.
B. Sections of Division 26 for electrical wiring, connections, and installation of control switches for electrically operated equipment.

1.05 SUBMITTALS

A. Comply with requirements of Section 01 33 00, "Submittal Procedures."
B. Submittal Data
   1. Submittal data is to be submitted as a complete, single digital file. All documents shall be clearly legible. Each submittal shall contain the below in the following order:
      a. Cover Sheet.
         1) Include name of supplying contractor and project name.
         2) Include submittal and revision number.
      b. Detailed Bill of Materials.
         1) Produce a matrix that includes the room number where the screen is to be installed, the screen model number, the screen size, the finished ceiling height in the room, the intended height above finished floor when the screen is deployed, and the required extra drop.
         2) The bill of materials shall be index referenced within the PDF file so that each product name is clickable, linked to the first page of the corresponding product data.
         3) Failure to provide this information will result in the rejection of submittals.
   2. Product Data.
      a. Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product.
      b. Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and

graphics/pictures.
c. If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight.
3. Authorized Distributor Certificate.
a. Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is an Authorized Distributor of the product being supplied.

C. Shop Drawings
1. Prior to ordering, submit drawings for approval. Drawings should be at project standard scale and clearly legible. These drawings shall include, but are not limited to, the following:
a. Title Sheet and Symbols Legend.
b. Details of any equipment modifications.
c. Anchorage details.
d. Plan drawings locating:
1) Projection screens.
2) Electrical wiring connection.
3) Control cable routing.
e. Elevation drawings for any fixed projection screens.
2. Resubmission of contract drawings does not constitute a complete shop drawings submittal and is unacceptable. Such submittals will be rejected.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For projection screens to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Obtain each type of equipment required from a single manufacturer as complete units, including necessary hardware and accessories.
B. Measure gain of screen viewing surface against that of a magnesium carbonate surface by means of a photogoniometer using testing methods and test apparatus per FS GG-S- 00172D (I) for determining the effect of reflected light at various viewing angles on screen surfaces.
C. Provide screen fabrics identical to those materials which have undergone testing and passed requirements for flame resistance as outlined in NFPA 701 per small sample test.
D. Provide a seamless mildew resistant screen fabric as determined by Federal Standard 191 A/5760.
E. State of the Art Development
1. Supply only the manufacturer's latest developed product. In cases where product development surpasses the criteria of the specification, inform the Architect and make the
a. newer product available to the project at no additional cost. In no case shall discontinued or obsolete product be acceptable. The same requirement applies to software programs developed/updated during the warranty period.
2. Should the product recall by the manufacturer require temporary or permanent replacement of a product specified under this section, notify the Architect at the earliest reasonable time and arrange to replace the product in question at the earliest possible time.
a. Product found defective or subject to recall prior to scheduled installation shall not be delivered to the jobsite.
b. Product defect or intended recall shall not relieve the manufacturer from his contractual obligation with regard to delivery schedule of product.
c. Under no circumstances shall arrangement for alternate product necessarily require the Owner to accept superseded equipment except on a temporary basis.

1.08 PROJECT CONDITIONS

A. Environmental Requirements: Comply with the manufacturers requirements for temperature and humidity conditions.

1.09 WARRANTY

A. The installed product warranty shall be for twelve (12) months from the date of final acceptance. All manufacturers' equipment warranties shall be activated in the Owner's name and shall commence on the date of final acceptance. Provide the Owner with a copy of this warranty with close out submittals. In the case of modified equipment, the manufacturer's warranty is normally voided. In such cases, provide the Owner with a warranty equivalent to that of the original

manufacturer.

B. There shall be no cost to the Owner for maintenance performed during the warranty period beyond the fixed cost of the contract.

PART 2 - PRODUCTS

2.01 AVAILABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work to include, but are not limited to, the following:
   1. Electric projection screens:
      a. Access V; Draper; Spiceland IN; 800-238-7999.
      b. Acumen V; Draper; Spiceland IN; 800-238-7999.
      c. Tensioned Advantage Deluxe Electrol, Da-Lite; Warsaw IN; 877-325-4832.
      d. Cima; Stewart Filmscreen; Torrance CA; 800-762-4999.
   2. Projection screen locations shall be in areas as indicated on “TA” Series drawings:
      a. Type A: 137-inch (diagonal measure), 16:10 aspect ratio. Wall mounted (Dining Room)
      b. Type B: 255-inch (diagonal measure), 16:10 aspect ratio. Wall Mounted (Gymnasium)
      c. Type C: 137-inch (diagonal measure), 16:10 aspect ratio. Ceiling Mounted(Multipurpose Room)

2.02 MATERIALS AND FABRICATION

A. Provide each electrically operated, ceiling recessed front projection screens manufactured
      a. as an integral unit consisting of roller, screen fabric, finished retracting “trap-door” assembly, mounting accessories and all other components for a complete installation and complying with all requirements.

B. The unit shall be UL-listed and bear UL re-examination markers.

C. Screen limitation drop, or permanent mounting position, will position the bottom of the displayed image as listed below. Provide extra drop at top of screens as required to position the bottom of the displayed image as listed below. Verify drop distance with ceiling height information prior to ordering equipment.
   1. 48-inches above finish floor.

D. Fabric: The image area shall be a completely seamless, polyvinyl, grey fabric with a gain of 0.9 to 1.0. It shall have a black border, black backing and be cable-tensioned to eliminate edge curl, sag, and center wrinkle.

E. Case: Aluminum or steel, and fire-retardant hardboard, with removable access panels on the bottom or side of the case. The unit shall have an integral motorized trap door. The case shall be finished to match ceiling on the bottom.

F. Motor: Size and capacity as recommended by the manufacturer for the screen. Provide an instant reversing, gear driven, or in roller, motor with permanently lubricated ball bearings, automatic thermal overload protection, and preset limit switches to automatically stop the screen in the fully "UP" or "DOWN" position. The stop action shall be positive to prevent coasting. The motor shall be acoustically isolated to limit operating noise.

G. Control: Provide low voltage (24 volts or less) controls wired to a junction box on the screen wall and to the associated audiovisual equipment rack. The wall plate shall have push button control for "UP", "DOWN", and "STOP". The same control functions shall be present at the junction box in the audiovisual control system via RS-232 connection.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment at locations indicated in compliance with the manufacturer’s instructions, including, but not limited to, Installation Instructions.

B. Install in position and relationship to adjoining work indicated, securely anchored to supporting substrate, sealed and finished, and in a manner, which produces a smooth screen with square, plumb, and straight edges.

C. Install with proper clearance between the gypsum board, the ceiling tiles, the screen, and the jam. Electric screens are to be installed with housing (case) concealed just above room ceiling tiles. Provide cutout opening with finish in drop tile or hard ceiling for screen drop.

D. The equipment shall be inspected upon arrival to the job site. The equipment shall be stored in their original crates until installation.

3.02 ADJUST AND CLEAN

A. Protect equipment after installation from damage during construction including, but not limited to, paint, scratches, and dirt. If, despite such protection, damage occurs, remove and replace damaged components or entire unit as required to restore units to their original, undamaged condition.
B. Adjust assembly after installation for proper operation and screen drop/ retract.

DIVISION 11 66 23 - ATHLETIC AND RECREATIONAL EQUIPMENT

PART 1 GENERAL

ELEMENTARY SCHOOLS MULTIPURPOSE/ ACTIVITY: Designers shall consider wall mounted adjustable goals one at each end of the multipurpose room for base bid. Designer to confirm/ verify programming needs for school. Ceiling heights shall be 22’ or higher clear inside to the bottom of any and all obstructions.
MIDDLE SCHOOLS: For base bid, six standard height backboards – two competition units on regulation court on main axis and four side retractable units defining two cross-courts. Retractable backboards shall be motorized with a manual back-up.

VOLLEYBALL NET INSERTS: Provide inserts on the floor for installation of volleyball net. Verify number of volleyball courts specific to design. Standards and judges chair shall be part of the construction contract. The net and support are not provided as part of the school contract.
HIGH SCHOOLS: Programming to be determined specific to the project. For base bid design, provide six standard height backboards with two competition units on regulation court and four retractable backboards at the sides with two on each side. Retractable backboards shall be motorized with a manual back-up. Volleyball inserts shall be included in design as well as PA, intercom, and data floor boxes. Retractable bleachers shall be included in design.

GYMNASIUMS shall be sized according to the building program. Middle and high school gyms shall be competitive/ regulation courts. Ceiling heights shall be 25' or higher clear inside to the bottom of any and all obstructions at high schools and 22’ clear in middle schools. New gym additions shall be designed to meet safe building criteria for existing schools.
Provide 10' or more overrun on ends of main court in high schools.
Make sure that side court backboards are not over the main court (make them retractable if necessary). Ensure that main and side court backboards will not intrude on required clearances for volleyball tournament play (25’ in retracted position).

BASKETBALL BACKSTOPS: Backstops shall be glass for main court, solid for cross courts unless budget allows for consistent finish for all. Rims shall be "breakaway" type. Retractable backstops shall be electrically operated. Provide protective pads at bottom rail.

SCOREBOARD: Wall mounted electronic type, with timeclock, team scores, period, bonus, jump ball, next possession, and possession. Timeclock shall be bi-directional with ability to directly set any number of minutes and seconds. Designers shall request preferred manufacturers from MSCS during design.
NO CENTER MOUNTED SCOREBOARDS WILL BE ALLOWED IN ANY SCHOOL.

SOCCER AND FOOTBALL GOAL POSTS: Shall be furnished and installed by Contractor.

VOLLEYBALL AND BADMINTON FLOOR SLEEVES: Provide floor sleeves for volleyball at high school and middle school gymnasiums. Sleeves shall be recessed steel with hinged floor plate. Top of floor plate shall be flush with wood floor. Floor plates shall be either solid brass or steel with chrome plated finish.

VOLLEYBALL EQUIPMENT: Contractor shall provide the standards and judge’s chair(s) for volleyball.

WALL PADS: 2" thickness, polyurethane foam, mounted on 3/8" plywood and covered with heavy duty vinyl and permanently mounted at end walls of main basketball courts at 8’-0” to each side of the center line of the goal. In auxiliary gyms, end walls of side courts shall also be padded. Designers shall include in project manual notes to ensure school colors and mascot graphics are included in the costs of the wall pads.

1.01 SECTION INCLUDES

A. Basketball backboards, goals, and support framing.
B. Floor sleeves for net and goal posts.
C. Wall mounted protection pads.
D. Volleyball nets and posts.
E. Scoreboards

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Concrete floor slab to receive floor sleeves and anchors.
B. *Division 05 12 00* - Structural Steel Framing: Structural members supporting basketball systems.

1.03 REFERENCE STANDARDS

A. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Large Components: Ensure that large components can be moved into final position without damage to other construction.
B. Electrically Operated Equipment: Coordinate location and electrical characteristics of service connection.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's data showing configuration, sizes, materials, finishes, hardware, and accessories; include:
    1. Electrical characteristics and connection locations.
    2. Fire rating certifications.
    3. Manufacturer's installation instructions.
C. Shop Drawings: For custom fabricated equipment indicate, in large scale detail, construction methods; method of attachment or installation; type and gauge of metal, hardware, and fittings; plan front elevation; elevations and dimensions; minimum one cross section; utility requirements as to types, sizes, and locations.
D. Erection Drawings: Detailed dimensional requirements for proper location of equipment.
E. Samples: Submit samples of wall pad coverings in manufacturer's available range of colors.
F. Operating and maintenance data for each operating equipment item.
G. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified with minimum 5 years of experience.
C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in manufacturer's original packaging with factory original labels attached.
B. Store products indoors and elevated above floor; prevent warping, twisting, or sagging.
C. Store products in accordance with manufacturer's instructions; protect from extremes of weather, temperature, moisture, and other damage.

1.08 WARRANTY

A. See Division 01 79 00 - Closeout Submittals, for additional warranty requirements.
B. Provide 1 year manufacturer warranty for defects in materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Gymnasium Equipment:
   1. Basis of Design: Porter Athletic Equipment Company[<>]: www.porterathletic.com/#sle.
   2. Draper, Inc: www.draperinc.com/#sle.
   3. Performance Sports Systems: www.perfsports.com/#sle.
   4. Approved Equal.
   5. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 GENERAL REQUIREMENTS

A. See drawings for sizes and locations, unless noted otherwise.
B. Provide mounting plates, brackets, and anchors of sufficient size and strength to securely attach equipment to building structure; comply with requirements of Contract Documents.
C. Hardware: Heavy duty steel hardware, as recommended by manufacturer.
D. Electrical Wiring and Components: Comply with NFPA 70; provide UL-listed equipment.
E. Structural Steel Fabrications: Welded in accordance with AWS D1.1/D1.1M, using certified welders.

2.03 BASKETBALL

A. Basketball System: Backstop assembly, backboard, and goal.
   1. Product: Basis of Design: #208 – rectangular glass backboard, #90949000 Forward Fold Backstop, #00900506 – Center-strut height adjuster, #10797100 – Backstop Safety Lock, #00256500 Torq-flex adjustable goal, #00326xxx – Pro-Pad Padding Kit, #712 & 713 Electric Winch, #00791-1X2 – Key Switch Assembly. All manufactured by Porter.
B. Ceiling-Suspended Backstop Assemblies: Capable of mounting both rectangular and fan-shaped backboards.
   1. Center Strut vertical front drop frame assembly shall consist of a main, center mast of 6-5/8" O.D. heavy-wall structural steel tube with diagonal side sway braces of 2-1/2" x 1-1/2" rectangular steel tubing. Ends of diagonal brace tubes shall be precision machine cut to provide maximum weld surface contact to form a unitized, back-to-hack triangular type structural design to provide superior lateral stability. (Formed, curved, pinch-cut or flattened type brace connections will not be considered as equal.) The 6-5/8" O.D. main stem of drop frame shall be suspended diagonally from superstructure with a 15 degree angle and a 4'-6" long vertical member for attachment of fan or rectangular backboard. Top horizontal mast hinge spreader to be of heavy 4" structural channel to support adjustable suspension hangers.
   2. Goal shall mount directly through backboard and into a heavy structural steel weldment Center Strut which shall be clamped to vertical 6-5/8" O.D. center support to eliminate any strain on backboard should a player hang on front mounted goal (conforms to NCAA latest rules). All fittings shall be attached to 6-5/8" O.D. vertical drop tube by heavy 1/4" thick precision saddle die-cut formed steel fittings secured in place by 5/8" diameter 'U'-Bolt type hardware. Upper backboard extension assembly shall provide official NCAA and NFHS regulation of 6" form front of Center-Strut to face of backboard.
   3. Center-Strut drop frame shall be suspended by two special adjustable hangers to provide for precise plumbing of frame during installation. Fifteen degree camber of main drop frame shall properly weight lock unit in playing position.
   4. Backstop to operate with 1-7/8" O.D. front brace assembly with folding knee joint. Knee joint to incorporate precision investment castings with special internal torsion spring design to lock brace assembly firmly in playing position. Knee joint assembly shall be designed with an in-line pivot design to maximize backstop stability during aggressive play. Hoist cable shall automatically disengage brace knee joint during hoist cycle through special three-pulley set-up.
   5. Backstop shall be supported from 3-1/2" O.D. pipe anchored to roof framing members by means of heavy, formed, die-cut steel support fittings. Each support fitting (supplied by the backstop manufacturer) to roof framing, must be capable of supporting a load exceeding 10,000 pounds, with sufficient attachment points to acquire a 60:1 safety factor for support of entire backstop superstructure system. Certified test results shall be furnished upon request. All cap screws shall be rated a minimum SAE Grade 5. Grade 2 cap screws will

not be approved as equal. Superstructure pipes to be reinforced with special truss-type bridging or bracing when truss centers exceed spans of 14'-0".

6. Backstop shall be provided as standard with heavy duty, fully enclosed worm gear type manual wall-mounted winch, designed to hold units at any position when raising or lowering backstop. Hoist cable shall be 1/4" diameter galvanized aircraft cable with 7,000 lb. ultimate breaking strength. Swivel pulleys shall be furnished with a 4" diameter cast (ductile iron) pulley sheave with a maintenance free, oil-impregnated bearing for proper hoist cable routing to winch. Pulley assembly and attachment to 3-1/2" O.D. support structure shall be rated at a minimum 9,000 pound load rating. Furnish certified test results upon request.
7. Limited Lifetime warranty on all Porter backboards when used in conjunction with the No. 900 Center-Strut series backstop. Backstop structure without said warranty will not be approved as equal.

C. Backboards: Tempered glass, rectangular shaped at each basketball backstop. Porter #208 Center Strut Mount Rectangular Glass Backboard.
   1. Backboard shall be 3'-6" x 6'-0" to meet all NCAA, NFHS and professional requirements.
   2. Backboard frame shall be of welded, unitized construction fabricated from heavy wall rectangular steel tubing, aluminum-faced for professional appearance.
   3. Unitized frame shall be designed to allow bottom two goal mount holes to pass beneath glass section to further alleviate stress on glass. Backboard frame shall be furnished with heavy steel gusset plates in top two corners incorporating keyhole slots for mounting backboard to direct-mount type support structure. Rear backboard frame shall be finished in durable neutral gray powder coated finish.
   4. Glass shall be provided in 1/2" thick, fully tempered (heat-treated) glass section with uniform load and impact strength. Official white border and target area shall be “fired in” permanently on front side of glass. Glass section shall be secured to unitized rear frame by means of L-shaped brushed aluminum extrusion. Front perimeter frame shall be secured to unitized rear frame with structural truss bead rivets. Glass section shall be fitted with shock absorbing neoprene material to cushion and protect glass section.
   5. Backboard protected by a limited lifetime warranty when installed on Porter Center-Strut support systems.

D. Safety Padding: (at each backboard) #326 bolt On Safety Padding
   1. Provide pad to fit any official size (72" wide) glass backboard. Pad shall consist of two pieces with molded type square comers for maximum safety, appearance and durability. Pads shall be molded from Polyurethane Foam (9 lb. density) with integral skin.
   2. Provide positive, bolt-on type attachment system to eliminate glue or peel and stick tape type attachment methods. Provide pad sections with internal, molded in steel attachment channel sections, which are secured to the backboard with special self-drilling, self-tapping attachment hardware provided in kit. Pad sections shall include molded-in clearance for goal mounting plate and center-strut feature, eliminating cutting in-field.
   3. Provide pad meeting all competition requirements of NBA, NCAA, NFHS, and international requirements of FIBA.
   4. Provide pad furnished with limited 8-year warranty.

E. Electric Winch (at each backstop) - 3/4 H.P. Electric Winch #707 - Heavy Duty Electric Winch
   1. Winch shall be worm gear type, designed to hold backstop at any position when raising or lowering. Winch housing and cable drum shall be of high strength ductile iron castings. The cable drum shall be grooved to provide neat and consistent cable tracking. The worm shall be machined from high strain tempered steel bar. All surfaces of worm shaft shall be ground and worm teeth and seal surfaces shall be polished after grinding for utmost in efficiency in sealing capabilities. Worm shaft shall turn in sealed, precision thrust bearings. The shaft shall also be sealed by an additional seal on outside of sealed bearings.
   2. Worm gear shall be machined from high strength forged bronze alloy for exceptional wearability and long life characteristics.
   3. The worm and gear shall be set to run in an oil bath within main shaft housing to be completely sealed by worm shaft seal, and by double lip seal around the polished cable

drum shaft where it enters the housing. Unit shall be filled with oil at factory and sealed, for maintenance free service.

4. Winch to be operated mechanically by means of 3/4 H.P. (13 amp) capacitor type 60 cycle, 115 volt, single phase electric motor with automatic thermal overload protection manufactured to NEMA specifications. The motor shall drive the winch by means of a connection V-belt and sprockets.
5. Drum shall be mechanically interconnected to a special rotary counting Up-Down limit switch assembly, which shall be mounted and pre-wired to motor as an integral part of winch. Limit switch shall be furnished in special, extruded aluminum housing. Adjustment of said limit switches designed to be easily made without use of tools. Winch shall be pre-wired with a 6'-0" lg. neoprene covered cable with NEMA L14-20 twist-lock grounded type plug attached.

F. Key Switches: Model No. XELE00791142 four switch on a 8-gang plate
1. Wall-Mounted Dual-Key Switch: Switch with separate “up” and “down” keys to prevent improper operation of system. Single key systems or “toggle” type switches are not approved. Operates four winches.
2. Momentary Switch: Switch automatically returns to “off” position if released.
3. Cover Plate: Flush-mounted stainless steel cover plate with manufacturer's label including operating instructions.
4. Key Switches: Key switches for all gymnasium equipment to be furnished identical.
5. Under no-load conditions, RPM of drum shall be 11.5, RPM of motor shall be 1725.
6. Hoisting capacity: 1600 pounds.
7. Wire electrical components in accordance with local area codes and manufacturer’s instructions. Electrical contractor to furnish and install all conduit, wiring, junction boxes and components not specified herein.

G. Adjustable Goal – Porter No. 00252-500 Torq-Flex Goal (Movable Rim)
1. Goal shall protect players and equipment by absorbing shock loads due to slam dunking or hanging on the rim, at all levels of competition.
2. Goal shall incorporate a precision, case-hardened, high-tensile steel alloy torsion rod pivot design to allow tip of rim to flex approximately 2-1/2" with a 230-pound static load. Tamper-proof torsion rod/pivot mechanism shall be pre-loaded during manufacturing process to meet proper (NCAA, NFHS & FIBA) ball rebound/elasticity standards. Goal shall instantaneously return to playing position when load is released. Torsion rod/pivot shall be designed to decelerate downward motion of goal on impact, to provide maximum player safety and minimize undue stresses on backboard and support system. Goals incorporating compression springs or shock absorber type mechanisms will not be considered as equal.
3. Fabricated rim from 5/8" diameter cold drawn alloy steel, round formed to an 18" inside diameter ring. Inside diameter of ring shall be positioned 6" from face of backboard by a heavy, 1/4" thick, formed steel hinged type housing. Heavy, 1/4" thick, formed steel goal mounting housing shall be fabricated with a keyhole type slot arrangement to facilitate mounting to backboard or direct-mount type support systems. Provide removable cover to completely conceal mounting bolt hardware.
4. Rigidly brace rim by means of 3/16" thick formed and die cut steel brace welded in position on underside of rim for maximum support. Provided rim with unique (tube-tie) net attachment system to eliminate conventional wire-formed type net locks for additional player safety.
5. Finish goal in durable, official orange powder-coat finish. Include durable, anti-whip type net and attachment hardware.
6. Provide goal with standard mounting centers for attachment to any 3'-6" x 6'-0" rectangular backboard.
7. Furnish with goal a limited 5-year warranty.

H. Basketball Backstop Safety Lock (at each backstop) No. 797- Saf-Strap
1. Lock shall be inertia-sensitive to automatically lock basketball backstop in position at any time in storage or during raising or lowering cycle due to sudden surge of speed created by possible malfunction of hoisting apparatus, such as winch, cable, pulleys, support fittings,

etc.

2. Safety lock shall incorporate a 2" wide nylon belt rated at 6,000-pound breaking strength and entire unit to be tested to withstand 1,500-pound free fall load. Strap shall extend 35'-0" maximum and shall be automatically retracted and stored on reel equipped with special negator type constant force spring. Operation and locking action of strap shall be by means of integral cast components activated by centrifugal force to lock basketball backstop before unit travels 12" of free fall. Unit shall incorporate a fully automatic reset requiring no poles, ropes, levers or buttons.
3. Furnished unit with a universal mounting bracket to fit on any size pipe mounted either parallel or perpendicular to unit. Supply belt with special belt connection bracket for ease of securing directly to basketball backstop.

I. Height Adjuster with Center Strut No. 901-506

1. Height adjustment unit shall be designed for use with No. 900 Center-Strut series ceiling suspended basketball backstop support systems to provide an adjustable, direct-mount (Center-Strut) goat attachment system to eliminate any strain on backboard should a player hang on ground mounted goal (conform to latest NCAA recommendation). Height adjustment units without prescribed direct-mount goal feature will not be approved as equal. Height adjustment feature shall allow goal height settings from 8'-0" to official 10'-0" for use by all age groups. Unit shall be designed for use with any official size (4' x 6' or 3'-6" x 6') rectangular backboard and companion front mount type goal.
2. Fabricate center unitized support frames by dual, 2-3/16" square heavy-wall zinc plated guide tubes located on 11-3/16" centers. Ends of guide tubes shall be welded to heavy, formed mounting brackets. Heavy formed, die cut steel clamp assemblies (2) shall be provided for securing height adjustment assembly directly to a 6-5/8" O.D. center support structure. Outer dual slide tubes shall support heavy structural steel angle sections which extend downward to accept a direct-mount goal mounting systems. Provide slide tube assembly with a heavy formed steel section to attach a special upper backboard support assembly to secure unit to upper two corners of rectangular backboard on standard (5'-6") mounting centers.
3. Finish height adjustment frame with one coat of flat black enamel. Furnish hardware for mounting unit to a 6-5/8" O.D. vertical support tube.
4. Limited Lifetime Warranty on all Porter rectangular backboards when used in conjunction with No. 00900-506 Center-Strut height adjustment unit installed on a Porter No. 900 Center-Strut series support structure. No. 901-506 - Center-Strut Height Adjustment System with Electric Key Switch Operation
5. Height adjustment unit shall incorporate a compact 115-vol gear motor type linear actuator with 600 pound thrust capacity to raise and lower goal height electrically. Motor shall draw 1.4 amps under full load. Integral limit switches shall provide automatic shut off at 8' and 10' goal heights. The motor shall be controlled by special dual keyed, flush wall-mounted momentary key switch. Switch assembly shall be furnished with 4-1/2" square stainless steel cover plate for mounting in masonry wall box by electrical contractor. Wiring from junction box on height adjuster frame to key switch shall be provided by electrical contractor to meet all local code requirements.
6. Wiring of all electrical components shall be in accordance with local area codes and manufacturer's instructions. All conduit, wiring, junction boxes and components not specified herein shall be furnished and installed by electrical contractor.
7. A height setting scale shall be located on side of unit to visually determine height settings from 8'-0" to 10'-0" in 3" increments.

2.04 FLOOR-MOUNTED EQUIPMENT

A. Volleyball Floor Sleeve for Posts: Basis of Design: Porter No. 00872200; metal sleeve, with brass latch cover, cast into concrete subfloor to hold poles for nets and goals; installed flush with finish floor surface.

1. Posts: 3-1/2 inch aluminum telescoping type with multiple height adjustments for tennis, badminton, and volleyball.
2. Judges Stand: Freestanding, folding stand with two 6" diameter wheels and protective padding.

2.05 WALL PADDING

A. Wall Padding: Foam filling bonded to backing board, wrapped in covering; each panel fabricated in one piece.
   1. Covering: Vinyl-coated polyester fabric, mildew and rot resistant; stapled to back of board.
      a. Graphics: Standard graphic design provided by architect in suitable format. Graphics to be printed on pads by a digital 4-color process. Graphic Pads that are silk-screened or made with adhesive vinyl shall not be considered equal. Graphics protected by a clear 3 mil laminate coating to protect against abrasion and fading.
      b. Texture: Embossed leather-look.
      c. Fabric Weight: 14 oz/sq yd, minimum.
   2. Foam, Fire-Rated: Open cell polychloroprene (Neoprene), with 5.5 pcf nominal density.
   3. Foam Thickness: 1-1/2 inches.
   4. Backing Board: Plywood.
   5. Manufacturers:
      a. Basis of Design: Draper, Inc; EcoVision Wall Pad: www.draperinc.com/#sle.
      b. IPI by Bison, Inc; Indoor Solid Color Vinyl Padding: www.ipibybison.com/#sle.
      c. SportPadding; www.sportpadding.com
      d. Approved Equal.
      e. Substitutions: See *Division 01 60 00* - Product Requirements.

2.06 SCOREBOARDS

A. Scoreboard: Indoor Basketball/Volleyball/Wrestling multi-sport scoreboard. Scoreboard /Control Operating Features:
   1. Timing: 13” High Intensity Red LED Digits. Bi-directional UP or Down count. Any number can be set between 0:00-99:59, 1/10th seconds display during final minute.
   2. Team Scores: 13” High Intensity Amber LED Digits. Displays 0-199.
   3. Period: 9” High Intensity Amber LED Digits. Displays 0-9.
   4. Next Possession-Serve-Advantage: High Intensity Amber LED. Displays arrow for each team.
   5. Bonus/Double Bonus: High Intensity Red LED. Displays the letter “B” for each team.
   6. Time of Day: In place of displaying game time on the scoreboard, the “time out” time may be displayed or the “time of day”. “Time of day” can still display after control turned off.
   7. Horn: Two located in scoreboard.
   8. Junction Box: Two (2) 4”x2-1/8” with covers, furnished per scoreboard for installation.
   9. Control Cable: One (1) length required of 2-wire (coaxial type) ¼” diameter.
   10. Segment Timing: Supported.
   11. Size: (2) 10’x3’x8” upper and lower cabinets (10’x6’x8”combined size). {8’x3’x8” standard.}
   12. Power: 120VAC, 0.51 Amps, 50/60 Hz. Requires earth ground.
   13. Aluminum face and perimeter frame: Fabricated from 0.050 inch minimum thickness, ASTM B221 aluminum sheet.
   14. Finish: Acrylic polyurethane paint. Color as selected by Architect/Engineer from manufacturer’s standard range.
   15. Manufacturer:
      a. Nevco, Inc.; Model 2702-NL (Non-Lit caption plates, base model) Scoreboard, www.nevco.com.
      b. Approved Equal.
      c. Substitutions: See *Division 01 60 00* - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Take field measurements to ensure proper fitting of work. If taking field measurements before fabrication will delay work, allow for adjustments within recommended tolerances.
B. Inspect areas and conditions before installation, and notify Architect/Engineer in writing of unsatisfactory or detrimental conditions.
C. Do not proceed with this work until conditions have been corrected; commencing installation constitutes acceptance of work site conditions.
D. Verify that electrical services are correctly located and have proper characteristics.

3.02 INSTALLATION

A. Install in accordance with Contract Documents and manufacturer's instructions.
B. Coordinate installation of inserts and anchors that must be built in to flooring or subflooring.
C. Install equipment rigid, straight, plumb, and level.
D. Secure equipment with manufacturer's recommended anchoring devices.
E. Install wall padding securely, with edges tight to wall and without wrinkles in fabric covering.
F. Separate dissimilar metals to prevent electrolytic corrosion.

3.03 ADJUSTING

A. Verify proper placement of equipment.
B. Verify proper placement of equipment anchors and sleeves, and use actual movable equipment to be anchored if available.
C. Adjust operating equipment for proper operation; remove and replace equipment causing noise or vibration; lubricate equipment as recommended by manufacturer.

3.04 CLEANING

A. Remove masking or protective covering from finished surfaces.
B. Clean equipment in accordance with manufacturer's recommendations.

3.05 PROTECTION

A. Protect installed products until Date of Substantial Completion.
B. Replace damaged products before Date of Substantial Completion.

DIVISION 11 66 53 – GYMNASIUM DIVIDERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: Electrically operated fabric gymnasium divider.
B. Related sections:
   1. *Division 05 12 00* - Structural Steel Framing: Structural steel framing to support gymnasium divider.
   2. *Division 26 2726* - Wiring Devices: Electrical supply, conduit, and wiring for motorized gymnasium divider.

1.02 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Submit:
   1. List of proposed products and product data.
   2. Loads to be transmitted to building structural members and requirements for supplementary bracing and structural support members.
   3. Shop drawings showing layout, elevations, dimensions, fabrication details, method of attachment and electrical wiring diagrams.
   4. Manufacturer must provide calculations and reports for tests performed by an independent testing laboratory accredited by the American Association of Laboratory Accreditation (A2LA) that clearly demonstrate compliance with minimum safety factors included in product specifications.
   5. Certificates for Divider Curtain Vinyl and Mesh to prove they meet the requirements of GreenGuard Gold.
   6. Samples of fabric for selection by Architect.
   7. Manufacturer's installation and maintenance instructions.

1.03 QUALITY ASSURANCE

A. Source limitation: All components including curtain, suspension system, electric winches, and controls for divider shall be products of a single manufacturer.
B. All welding to be performed by personnel having passed Welder Qualification testing in accordance with American Welding Society (AWS) code D1.1 or higher. Manufacturer to provide certification and test results upon request.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver divider until building is enclosed and other construction within gymnasium is substantially complete.

PARTS 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Draper, Inc., 411 South Pearl Street, Spiceland, Indiana 47385-0425; 765-987-7999.

B. Approved Equal.

C. Substitutions: See *Division 01 60 00* - Product Requirement

2.02 GYMNASIUM DIVIDER

A. ROLL-UP GYM DIVIDER

1. Type: Electrically operated, roll-up gymnasium divider including motor, belts, controls, clamps for attachment to building structure, threaded rod supports, and other components required for complete functional installation; Roll-Up Gym Divider as manufactured by Draper, Inc.
2. Operation: Curtain rolled up and down by belts wound onto overhead rotating drive pipe operated by electrical motor.
3. Configuration: Rectangular shape with straight bottom and extending across room as indicated on Drawings.
   a. Maximum dimension of stored divider: 2 feet from bottom of structural support to bottom of rolled curtain.
   b. Minimum required clearance between vertical curtain edges and adjacent fixed objects: 6 inches.
   c. Provide min. 36 inches, (or as indicated on drawings) space between curtain ends and walls or fixed objects to allow passage space around divider.
4. Operating mechanism: Drive pipe winch powered with 3/4 HP, 110VAC, 60-cycle, single-phase, reversible capacitor, C-Face motor with thermal overload protection. Winch assembly shall carry a five-year warranty. Provide with load holding worm gear reduction and integral limit switches to control curtain travel. Drive pipe shall rotate in pipe support assemblies spaced at approximately 9 feet (2.7 m).
5. Attachment: Attach to structural support with beam clamps, hanger brackets, and 1/2 inch diameter threaded rods. Attachment clamps designed to be capable of supporting a minimum of 5,000 lbs. each and provided in sufficient number to provide a combined minimum 45:1 attachment point safety factor.
6. Hoist belts: 5 inches wide white polyester webbing attached to drive pipe, passing under bottom batten, and terminating at top batten. Space belts at approximately 15 feet.
7. Bottom roller: 4 inches diameter steel pipe with aluminum strip for attachment of curtain.

2.03 CURTAIN

A. Full height curtain Bottom 8 feet: Opaque solid vinyl coated polyester fabric:
   1. Weight: 18 ounces per SY.
   2. Resistant to rot, mildew, and ultraviolet light.
   3. Flammability: Rated self-extinguishing in accordance with California State Fire Marshall Title 19.
   4. Color: *Division 09 00 00* - Material Color Schedule.

B. Full height curtain Upper curtain section: Vinyl coated polyester mesh.
   1. Weight: 9 ounces per SY.
   2. Resistant to rot, mildew, and ultraviolet light.
   3. Flammability: Rated self-extinguishing in accordance with California State Fire Marshall Title 19.
   4. Color: As indicated on drawings.

C. VOC Emission: Divider Curtain Vinyl and Mesh to be low emitting and certified to meet all of the requirements of the GREENGUARD Gold certification program. GREENGUARD Gold requires emissions of total volatile organic compounds = 0.22 mg/m3, formaldehyde = 0.0135 ppm, total aldehydes = 0.043 ppm, individual volatile organic compounds = 1/1000 TLV and = ½ chronic REL and total phthalates = 0.01 mg/m3. Vinyl and Mesh must be evaluated to indoor air quality evaluation (IAQ) using a GREENGUARD product evaluation protocol following the requirements of The GREENGUARD Product Certification Program, ASTM Standard D5116 and the United States Environmental Protection Agency and modeled based on GEI requirements for a standard gymnasium loading and ASHRAE 62.1 – 2004 ventilation conditions. Manufacturer to

provide certificate and/or test results upon request.

D. Seams: Horizontal and electronically welded with 1-inch full contact weld.
E. Outer edge hems: Turned with double welds.
F. Top edge: Solid fabric in triple thickness and double welded to (mesh) (solid curtain fabric) to form 6 inches wide pocket for top pipe batten.
G. Bottom edge cut square for attachment to roller pipe with aluminum stop strip.

2.04 CURTAIN SAFETY DEVICE

A. Provide Draper Model 504321 Curtain Lock safety device. Curtain Lok to be directly speed sensitive to automatically lock divider curtain in position at any time during storage or operation. In the event of an over-speed situation (greater than 1.5 feet (45.7 cm) per second) caused by malfunction of the hoisting apparatus, whether sudden or gradual, device will immediately activate.
B. Provide Draper Model 503229 Aut-O-Loc 2 safety device. Aut-O-Loc 2 to be sensitive to automatically lock divider curtain in position at any time during storage or operation. Aut-O-Loc 2™ is permanently locked when a load of more than 1000 pounds (453.6 kg) of force is captured and will not be functional after it has caught a significant load to prevent possible re-use and failure of critical components that are stressed when the unit engages a load.

2.05 CONTROLS

A. Provide key lock, 3-position, momentary contact wall control switch to lower, raise, and stop gymnasium divider. Provide with switch box and plastic cover plate.
B. Provide EZ-Pad Plus Group Controller capable of controlling Electric Divider Curtains, Electric Height Adjusters, Basketball Backstops with Electric Winches, Wrestling Mat Lifters and other Auxiliary Devices from a centralized location. Group Control Systems is fully field programmable and supports individual device operation as well as operation of items of part of one or more group of up to 8 devices.
C. Devices are controlled via 120V relay/controller panels that may be mounted at remote location(s.) Each relay panel includes 18 relays configured in eight directional control pairs and two on-off individual relays. As many as (16) Relay Boxes may be networked to allow up to (128) directional gym equipment devices and up to (32) on-off auxiliary items to be operated. Relay Boxes shall distribute power to the appropriate devices as a result of commands entered at the Touch Pad. Relay Boxes shall be dual powered and sized to accept two 120-volt, 30-amp, single-phase circuits.
D. User interacts via low voltage, momentary contact, Touch Pad (12V) to communicate with the Relay/Controller enclosure. Touch pad should be mounted at such a position in the gymnasium as to allow a clear line of sight to all the equipment under the control of the system. Touch Pad shall be flush mounted and fit into a standard 8-5/8" x 4-1/2" x 2-1/2” electrical box (RACO Box #942 or equivalent). Touch Pads to have password protection to prevent usage by unauthorized personnel. Password protection is programmable and is multi-level with a 6-digit user’s security code as well as a separate 6-digit supervisor’s code. User code allows for operation of individual devices and pre-defined groups. Supervisor’s code allows same functions as user’s code plus the ability to change passwords, define groups and change reset time period. Touch Pad also has a hard coded manufacturer’s backdoor password which can be provided by manufacturer in case passwords are compromised or forgotten. Touch Pad automatically reverts back to secure mode if inactive for more than the user defined reset time period. Multiple Touch pads (up to 16) can be used on one any system.
E. Groups shall be definable by user with supervisor password. Groups are stored in each Touch Pad and each touch pad can support up to 10 groups with a maximum of eight devices per group. A maximum of four devices per relay/controller box can be included in a single group. Touch Pad includes logic to prevent the creation of groups that create a circuit overload.
F. Complete control system to include a combination of Model 503058 Relay/Controller Panels and Model 503057 Touch Pads.
G. ELECTRICAL CONTRACTOR SHALL PROVIDE AND INSTALL: All conduits, wires (including low voltage), touch pad mounting box and programming.
H. Provide Smart Gym Group Controller capable of controlling Electric Divider Curtains, Electric Height Adjusters, Basketball Backstops with Electric Winches, Wrestling Mat Lifters and other Auxiliary Devices from a centralized location. Group Control Systems to have 120V control

processor that is fully programmable to operate gymnasium equipment and auxiliary devices provided by others. Group Control System must be capable of operating up to 1000 devices and can be programmed to operate single devices or groups of up to four devices simultaneously.

I. Devices are controlled via 120V relay panels that may be mounted at remote location(s.) Each relay panel includes 8 relays. Devices that operate in an up/down or in/out cycle require two relays; devices that operate in an on/off cycle require one relay. Communications between processor and the relay panel(s) is 24V.

J. User interacts via a 24V flush mounted graphical color touch screen to be custom programmed to match the project conditions. Touch screen to require entry of four-digit security code prior to accessing control screens. Security code is to be fully programmable by the user. Touch screen should be mounted in full view of equipment being operated and a minimum of one touch screen should be each room with equipment being operated.

K. Complete control system to include one pre-programmed Model 503024 control processor and power supply in 18" x 18" x 6" surface mounted enclosure, the required number of Model 503027 relay panels in surface mounted 15" x 8" x 2" surface mounted enclosure and the requested number of (Model 503025 Grayscale or Model 503026 color) graphical touch screen to be mounted in 4 ½" x 4 ½" x 2 ½" electrical box.

L. ELECTRICAL CONTRACTOR SHALL PROVIDE AND INSTALL: All conduits complete with wire from power source to control processor, from control processor to relay panels, from relay panels to devices and from control processor to touch screen and one 4 ½" x 4 ½" x 2 ½" electrical box for mounting touch screen.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate support of gymnasium divider with roof structure to ensure proper distribution of loads and adequacy of attachment points. Ensure that building structure has been designed for loads of specific gymnasium divider to be provided. Provide additional structural framing members as required in accordance with Section 05 1200 - Structural Steel Framing.

B. Coordinate configuration, size, and installation of gymnasium divider with height, slope, and type of building structure and lighting fixtures, mechanical equipment, ductwork, fire-suppression system, bleachers, athletic equipment, and other potential obstructions.

C. Field verify dimensions prior to fabrication.

D. Coordinate electrical requirements for motorized operating mechanism to ensure proper power source, conduit, wiring, and boxes for keyed switches. Prior to installation, verify type and location of power supply.

E. For installations made after wood gymnasium flooring is installed, provide protection and exercise care so as not to damage flooring.

3.02 INSTALLATION

A. Install in accordance with manufacturer's written instructions and shop drawings.

B. Install even and level with curtain hanging 2 inches (50 mm) above floor in down position.

C. Install control switch such that operator has view of complete gymnasium divider during lowering and raising.

D. Adjust limit switches of electric winch to ensure accurate position in both stored and lowered positions.

3.03 TESTING AND DEMONSTRATION

A. Operate divider curtains to ensure proper lifting and lowering. Adjust as required to ensure smooth operation and accurate positioning.

B. Demonstrate to Owner's designated representatives' complete operation and required maintenance.

DIVISION 11 66 73 - STAGE CURTAINS

Stage / Platform Curtains must be tested in accordance with the large-scale tests of NFPA701. In addition to the written certificate, all must have a label permanently attached to the back of the curtain (within reach of the stage floor) noting the certification.

Design layout and support shall be determined specifically to school type (ES, MS, K8, HS) and needs of school administration and staff. Designs shall include custom valance specific to school colors.

DIVISION 12 00 00 - FURNISHINGS

FURNITURE AND EQUIIPMENT: FFE or Furniture, Fixtures, and Equipment such as chairs, desks, tables, etc., will be specified and the acquisition of the FF&E will be determined to bid acquired within the project or by separate bid. Designers to provide a typical furniture layout for all standard spaces and furniture layout for specialized rooms such as project rooms, science labs, art rooms, media rooms, etc. All built-in casework and equipment required for classrooms, kitchen and offices shall be included in the design and bid as part of the contract for construction. Verify with the Owner if there is any “built in casework” that may be provided by the MSCS Furniture Contract. Layouts for Owner-provided furniture will be developed by the designer in cooperation with the owner and all needed services (plumbing, electrical, etc.) provided in the design of the building.

DIVISION 12 20 00 - WINDOW TREATMENTS

PART 1 GENERAL

Window shades shall be provided by the Contractor. Designers shall allow adequate space at window heads for installation of room darkening shades with a fascia or valance to conceal the roller assembly. Specify perforation with 6% open area. Designers shall locate window shades for interior windows as required for tactical safety such as classroom windows along corridors.

1.01 SECTION INCLUDES

A. Interior manual roller shades.

1.02 RELATED REQUIREMENTS

A. *Division 06 10 00* - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

C. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.

B. Sequencing:

1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
2. Do not install shades until final surface finishes and painting is complete.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

D. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

E. Selection Samples: Include fabric samples in full range of available colors and patterns.

F. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

G. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

I. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

J. Maintenance contracts.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum five years of documented experience with shading systems of similar size and type.

1. Manufacturer's authorized representative.

C. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

D. Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

1.07 MOCK-UP

A. See *Division 01 43 39* - Mockups for additional requirements.

B. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams and batten pockets when applicable.

1. Location: Where indicated on drawings.
2. Obtain Architect/Engineer's approval of light and privacy characteristics of fabric prior to fabrication.
3. Full-sized mock-up may become part of the final installation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.09 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:

1. Shade Hardware: One year.
2. Fabric: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Manually Operated Roller Shades:

1. Basis of Design: MechoShade, LLC; Mecho/5 SSystem:www.mechoshade.com/#sle.
2. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com/#sle.
3. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglasarchitectural.com/#sle.
4. Lutron Electronics Co., Inc; Contract Roller Manual Roller Shades: www.lutron.com/#sle.
5. Approved Equal.
6. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 ROLLER SHADES

A. General:

1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Roller Shades Type WS-1:

1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
   a. Drop Position: Regular roll.
   b. Roll Direction: Roll down, closed position is at windowsill.
   c. Mounting: Surface mounted in window pocket. Recess mounted in ceiling pocket
   d. Size: As indicated on drawings.
   e. Fabric: As indicated on drawings.
2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
   a. Material: Stamped steel.

3. Roller Tubes: As required for type of shade operation.
    a. Material: Extruded aluminum, clear anodized finish.
    b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
    c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
    d. Take-Up Roller: Manufacturer's standard roller tube pretensioned for winding lift cable in bottom-up type shades.
4. Hembars: Designed to maintain bottom of shade straight and flat.
    a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
5. Accessories:
    a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners: clear anodized finish
        1) Finish: Baked enamel.
        2) Color: As indicated on drawings.
        3) Profile: Square.
    b. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

2.03 SHADE FABRIC

A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
1. Manufacturers:
    a. Basis of Design: MechoShade Systems, LLC; ThermoVeil Basket Weave - 1300 Series (5% open): www.mechoshade.com/#sle.
    b. Lutron Electronics Co., Inc; E Screen THEIA - 1%: www.lutron.com/#sle.
    c. Approved Equal.
    d. Substitutions: See *Division 01 60 00* - Product Requirements.
2. Material: 75% PVC, 25% polyester.
3. Performance Requirements:
    a. Flammability: Pass NFPA 701 large and small tests.
    b. Fungal Resistance: No growth when tested according to ASTM G21.
    c. Solar Transmittance (Ts): 6.
    d. Visible Light Transmittance (Tv): 5.
    e. Solar Absorption (As): 69.
    f. Solar Reflectance (Rs): 25.
4. Weight: 19.7 ounces per square yard.
5. Roll Width: 126 inches.
6. Color: As indicated on drawings.

2.04 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.
B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
1. Vertical Dimensions: Fill openings from head to sill with 1/2-inch space between bottom bar and window stool.
2. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4-inch total.
3. Horizontal Dimensions - Outside Mounting: Extend shades 2 inches beyond jambs on each side.
C. Dimensional Tolerances: As recommended in writing by manufacturer.
D. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.
B. If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before proceeding.
C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.
B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.
B. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours training by manufacturer's authorized personnel at location designated by the Owner.

3.06 PROTECTION

A. Protect installed products from subsequent construction operations.

DIVISION 12 35 53 - LABORATORY EQUIPMENT AND ART ROOM CASEWORK

PART 1 GENERAL

Refer to *DIVISION 06 41 00* - INTERIOR ARCHITECTURAL WOODWORK for general construction requirements.

Basis of Design can use systems by Sheldon and Institutional Casework Incorporated.

Contractors should be required to submit samples of transparent wood casework finish which indicate range of color variation to be expected in finishes.

Both built-in and portable casework shall work together as a system and shall be by the same manufacturer.

CASEWORK: Visible surfaces shall be solid oak and oak plywood construction. Unexposed materials shall be solid wood and hardwood veneer plywood. Veneered particle board is not acceptable for this use.

COUNTERTOPS: Shall be acid resistant solid epoxy resin or similar material approved by the Project Manager. Sinks shall be of the same material. Coated wood tops are not acceptable.

ART ROOM COUNTERTOPS: Shall be solid epoxy resin or similar material approved by the Project Manager. Sinks shall be of the same material. Coated wood tops are not acceptable.

FITTINGS: Shall be vandal-resistant.

HARDWARE: Shall be heavy-duty, stainless steel. All locks for all lab casework shall be master-keyed to a single key for each space and grand-mastered for a single key for each facility. Hardware shall be ADA compliant.

EYEWASH AND SAFETY SHOWERS: Are required in each middle school and high school science room not dedicated to physics. Eyewash stations are required in all preparation rooms and recommended for elementary school science rooms.
Maximum travel distance from every workstation to:

- Eye Wash: 25 feet (within 10 seconds of each workstation)

- Shower: 50 feet

A minimum of one eyewash and shower shall be accessible. Each eyewash and safety shower shall be supplied with lukewarm water. Provide a mixing valve for each individual or group of closely located safety equipment. Water temperature shall be adjusted to be in compliance with ISEA Z358.1 Depressed/ sloped slabs and drains shall be provided at each station as required. A compartmental shower unit will be acceptable.

FLAMABLE AND ACID STORAGE CABINET- in Middle and High School projects, the contractor shall provide a combination acid and flammable storage cabinet approximately 35"W x 35"H x 22"D for basis of design.

GOGGLE STORAGE/STERILIZATION CABINET: In Middle and High School projects provide a cabinet which stores and sterilizes safety glasses and goggles using ultraviolet light. The unit shall accommodate 40 goggles or 40 safety glasses.

FUME HOOD: In 8th grade science rooms and High School projects provide a 4' fume hood, work surface and ADA base unit. As a basis of design for the hood, refer to the Protector Premier Laboratory Hood #100400002.

1.01 SECTION INCLUDES

A. **Laboratory Furniture**: Provide and install all wood and laboratory casework, benches and fume hoods; which includes, but is not limited to wood casework, countertops, reagent shelves, fume hoods, tables, standards, filler panels, scribes, knee space panels, accessories, utility space closure panels between base cabinets and at exposed ends of utility spaces, laboratory sinks, cup sinks, cup drains, strainers, overflows and sink outlets, and miscellaneous items of equipment as listed in the specifications or as shown on drawings. Work includes all laboratory furniture depicted on drawings or listed in these specifications unless otherwise noted as "Not in Contract" (NIC) within the drawings, equipment schedule or said specifications.

B. **Plumbing Fixtures**: Furnish, deliver, and install the fixtures at service outlets that are either listed in these specifications, depicted in drawings, or identified in the equipment schedule as being affixed to laboratory casework. Installation is to be "hand tight" only, final connection is by others.

C. **Electrical Service Fixtures**: Furnish, deliver, and install the electrical service fixtures that are either listed in these specifications, depicted in drawings, or identified in the equipment schedule as being affixed to laboratory casework. Installation is to be "hand tight" only, final connection is by others.

D. **Plumbing and Electrical Service Fixtures on Fume Hoods**: All service connections on fume hoods are to be made at the factory. Fume hoods are to be pre-piped to a single outlet above or below the fume hood on each side independently, depending on the location of the plumbing rough in. Wiring and electrical conduit for electrical devices included with the fume hood assembly are to be pre-wired to a single junction box located at the top of the fume hood. Final connection for all services from the fume hood is to be made by others. Bulbs for the light fixture are to be provided and installed by owner as an item of maintenance.

E. **Sink Bowls and Cup-sinks Integral with Countertops**: Furnish, deliver, and install all sinks bowls, cup-sinks and tail pieces (if shown or specified) at locations that are listed in these specifications, depicted in drawings, or identified in the equipment schedule. Sinks and cup-sinks are to be installed within the countertop with final connection to the drain piping system by others.

F. **Utility-space closure panels between base cabinets** and at exposed ends of utility spaces.

G. **Utility-space framing at backs of base cabinets and between backs of base cabinets**.

H. **Fume Hoods**.

I. **Patriot Tables**.

J. **Related equipment**.

1.02 RELATED SECTIONS

A. Related Work to be Performed by Others:

1. Final installation of all plumbing, service and electrical fixtures attached to casework or countertop (excluding piping and wiring within fume hoods).
2. Final connection to service lines of all plumbing, service and electrical fixtures attached to

laboratory casework or furniture.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
C. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
D. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
E. NFPA 30 - Flammable and Combustible Liquids Code; 2024.
F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
G. SEFA 1 - Laboratory Fume Hoods; 2010.
H. SEFA 7 - Laboratory Fixtures; 2021.
I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
J. UL 1805 - Standard for Safety Laboratory Fume Hoods and Cabinets; Current Edition, Including All Revisions.

1.04 DEFINITIONS

A. “Concealed Portions of Casework” are surfaces that are not visible after installation; bottoms of cabinets less than 30 inches above finished floor; tops of cabinets 72 inches or more above finished floor (and not visible from an upper level); stretchers, blocking and/or components concealed by drawers; corners created by tall, wall, or base cabinets that are non-accessible.
B. “Exposed surfaces” are surfaces that are visible when: drawer fronts and doors are closed; cabinets and shelving are open or behind clear glass doors; bottoms of cabinets are seen 48 inches or more above the finished floor; tops of cabinets are seen below 72 inches above finished floor or are visible from an upper floor or raised area after installation.
C. "False Fronts" are nonfunctional fronts attached to particular units that mimic drawer box fronts to create an uninterrupted visual image of an elevation.
D. "Flush Inset" occurs when doors and drawer faces are inset within the side members of the cabinet in the same plane.
E. “Partial Overlay” is the reveal between cabinets created by the hinge at the edge of the cabinet. This reveal will be used for all exterior reveals on the project.
F. “Laboratory Casework Contractor/Manufacturer” is defined as the manufacturer and/or manufacturer’s representative that is to provide and install the laboratory casework, equipment, and accessories listed under the specifications, laboratory equipment schedule and/or illustrated on drawings.
G. “Reveal” is the measurement between individual door and drawer components on the face of a cabinet and between doors and drawers from cabinet to cabinet.
H. “Semi-exposed surfaces” are surfaces that are visible when: opaque doors are open, or drawers are extended; bottoms of cabinets are more than 30 inches and less than 42 inches above finished floor.
I. “Service Fixtures” are laboratory gas, air, and vacuum cocks; hot, cold and reagent water faucets; remote control valves, electrical receptacles (with necessary flush mounting hardware), fluorescent and/or incandescent light fixtures, light switches and/or motor switches for fume hoods and other items which serve as an operational part of the equipment.
J. “Service Lines” are the necessary piping and drain lines for laboratory gas, air and vacuum as well as hot, cold and reagent grade water that convey the respective services from building rough ins through floors or walls through equipment to the previously defined service fixtures. Also included are conduits, junction boxes, conduit fittings, wire disconnect switches and fuse or circuit breakers necessary to conduct electrical services from building rough ins through floors or walls through equipment to service fixtures.

1.05 SYSTEM DESCRIPTION

A. Cabinet and Casework Area Design:
    1. Partial overlay with 1/8" reveals between cabinet doors and drawers and 1/8" reveal at cabinet edge.
    2. Veneer matching grain on doors is vertical and vertical on drawers.
    3. Doors and drawer fronts are to have hardwood waterfall edges 5/8” thick on sides, and flat 5/8” thick hardwood edges on tops and bottoms.
    4. Rolled edge banding is not allowed.

5. All shelving shall be powder coated 20-gauge steel.
6. Patriot Tables.

1.06 SUBMITTALS

A. Submit under provisions of *Division 01 30 00*.
B. Product Data and Details: Manufacturer's data sheets on each product to be used, including.
   1. Test reports certifying that the casework finishes comply with SEFA-8 standards for chemical and physical resistance performance requirements.
   2. Performance test reports from an independent testing lab on each specified top material.
   3. Preparation instructions and recommendations.
   4. Storage and handling requirements and recommendations.
   5. Installation methods.
C. Shop Drawings:
   1. Indicate locations of blocking and reinforcements required for installing laboratory casework.
   2. Indicate locations and types of service fittings, together with associated service supply connection required.
   3. Include details of utility spaces.
   4. Include indicators of exposed conduits, if required, for service fittings.
   5. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
   6. Include coordinated dimensions for laboratory equipment specified in other Sections.
D. Selection Samples: For each finish product specified, one complete set of color chips representing manufacturer's full range of available colors and patterns.
   1. One set of samples indicating full range of finishes for countertop specified.
   2. One set of casework samples indicating full range of finishes for casework specified.
   3. One (1) 24" (600mm) wide, full-height base cabinet. Construction to consist of one (1) drawer, one (1) door, one (1) cupboard with adjustable half/full depth shelf and related hardware (pulls, hinges, drawer slides, etc.), complete with finish.
   4. One 36" (900mm) wide x 36" (900mm) high wall cabinet: Construction to consist of two adjustable shelves as well as related hardware and doors, complete with finish.
   5. Stain and Finish Samples
      a. A minimum of six (6) standard manufacturer’s samples, constructed of the same material from which the casework will be constructed, stained and clearly identified, should be submitted to the architect for color selection.
      b. Stain and finish samples will be retained by the architect or owner’s representative.
E. Quality Assurance/Control
   1. Design Data/Test Reports: Manufacturer shall submit test data and design criteria which are in compliance with the project specifications. Testing of safety devices and performance criteria shall be performed by a third-party validator.
   2. Certificates: All certifications required in the specifications should be submitted with the original submittal package under separate cover. Certificates must be provided with the signature of a qualified individual of the supplier.
   3. Manufacturer’s Instructions: Provide manufacturer’s instructions for installation and maintenance of all products provided and installed within this section. Instructions should be in bound form, tabbed and organized by section number.

1.07 QUALITY ASSURANCE

A. Qualification of Bidder/Manufacturer: The following list of information should be provided to the Owner/Architect at least ten (10) days prior to the bid opening:
   1. List of manufacturing facilities.
   2. A list of ten (10) installations of comparable stature completed within the past 5 years.
   3. Construction details depicting the materials, sizes, and methods of construction.
   4. Independent laboratory test reports that include information on cabinet, fume hood and tabletop finish and performance that have been conducted within the last two years.
B. Installer Qualifications:
   1. Firm with 10 years’ experience in installation or application of systems similar in complexity to those required for this Project, plus the following.
   2. Authorized distributor of manufacturer.

C. Mock-Ups:
    1. Installation in area designated by Architect.
    2. Do not proceed with remaining work until installation is approved by Architect.
    3. As selected and required by Architect's request for mock-up: Install base cabinet with drawer and cupboard, one adjustable shelf, hinged door, and applicable hardware. Wall case with adjustable shelf, hinged door, and applicable hardware. Tall case with adjustable shelves, fixed center shelf, hinged door, and applicable hardware, including a 3-point latching system.

1.08 DELIVERY, STORAGE AND HANDLING

A. Packaging, Shipping, Handling and Unloading:
    1. Packaging: Products should have packaging adequate to protect finished surfaces from soiling or damage during shipping, delivery and installation. Store products in manufacturer's unopened packaging until project conditions are ready for installation.
    2. Delivery: Casework delivery should only take place after painting, utility rough-ins and related activities are completed that could otherwise damage, soil or deteriorate casework in installation areas.
    3. Handling: Care, such as the use of proper moving equipment, experienced movers, etc., should be always used to avoid damaging the casework. Until installation takes place, any wrapping, insulation, or other method of protection applied to products from the factory should be left in place to avoid accidental damage.
B. Acceptance at Site: Casework will not be delivered or installed until the conditions specified under Part 3, Installation section of this document have been met.
C. Storage: Casework should be stored in the area of installation. If, prior to installation, it is necessary for casework to be temporarily stored in an area other than the installation area, the environmental conditions shall meet the environmental requirements specified under the Project Site Conditions article of this section.
D. Waste Management and Disposal: The supplier of the laboratory casework is responsible for removing any waste or refuse resulting from the installation of, or work pertaining to, laboratory casework; thereby leaving the project site clean and free of debris. Trash container/s to be provided by others.

1.09 PROJECT SITE CONDITIONS

A. For delivery and installation of laboratory casework and equipment, building conditions shall comply with AWI Standard 1700-G-3 and 1700-G-4 and be as follows:
    1. Flooring required to be placed under casework and equipment installed.
    2. Wood or metal blocking (wall grounds) installed within partitions to allow for immediate installation upon delivery.
    3. Heating and air conditioning systems providing consistent temperature and humidity conditions to comply with by AWI Standard 1700-G-4 and 1700-G-5.
    4. Relative humidity not less than 40 percent, nor more than 60 percent.
    5. Temperatures not less than 65 degrees Fahrenheit and not greater than 80 degrees Fahrenheit in areas of casework and equipment installation.
    6. Overhead mechanical, electrical and plumbing rough-in work is complete.
    7. Wet operations complete prior to delivery.
    8. Ceiling grids (with or without ceiling tiles), overhead soffits, ductwork and lighting installed.
    9. Painting complete.

1.10 WARRANTY

A. Casework Manufacturer Warranty: 3 years from date of delivery. Warranty is for the conditions indicated below, and when notified in writing from Owner, manufacturer shall promptly investigate, and address said deficiencies:
    1. Defects in materials and workmanship.
    2. Deterioration of material and surface performance below minimum SEFA 8 standards as certified by independent third-party testing laboratory.
    3. Within the warranty period, we shall, at our option, repair, replace, or refund the purchase price of defective casework.
B. Casework manufacturer shall be notified immediately of defective products and be given a reasonable opportunity to inspect the goods prior to return. Casework manufacturer will not

assume responsibility, or compensation, for unauthorized repairs or labor. Casework manufacturer makes no other warranty, expressed or implied, to the merchantability, fitness for a particular purpose, design, sale, installation, or use, of casework; and shall not be liable for incidental or consequential damages, losses of or expenses, resulting from the use of their products.

1. The warranty with respect to products from another company sold by the casework manufacturer is limited to the warranty extended by that other company.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers of Wood Casework:
   1. ICI Scientific, which is located at: 1865 HWY 641 N.; Paris, TN 38242; Tel: 731-642-4251; Email: request info (mcook@iciscientific.com); Web: www.iciscientific.com.
   2. Approved Equal.
   3. Substitutions: See *Division 01 60 00* - Product Requirements.
   4. 10-day prior approved substitution. Must be approved in writing by the architect and all substitutions are still subject to strict compliance with this specification regardless of what the manufacturer's "standard product" is and regardless of approval architect's or owner's approval of a sample product. After 1 submittal for substitution, architect and/or owner have the right to reject any substitution requests.
   5. Product Designations: Other manufacturers' laboratory casework of similar sizes, similar door, and drawer configurations, and complying with the Specifications, including certification to SEFA-8 standards for construction and chemical resistance, may be requested for approved substitution. Requests for substitutions will be considered in accordance with provisions of *Division 01 60 00*.

B. Applications/Scope:
   1. Casework Group: Manufacturer shall offer an integrated product line serving the user function indicated with a coordinated design, supply and installation of casework, equipment, work surfaces, and accessories.
      a. General casework.
      b. Laboratory.
      c. ADA compliant.

2.02 MATERIALS

A. Construction
   1. Wood veneer on plywood core: ICI Scientific Casework.
   2. Cabinet finish, Interiors, and exterior match finished:
      a. Wood species: Red Oak, Rift Cut.
      b. Finish: #5000 - Harvest.
   3. Drawer and Door Styles:
      a. Legend series drawer and door styling: both door and drawer fronts are [3/4] inch thick; have 5/8" thick hardwood waterfall edges on sides, and 5/8" thick flat hardwood edges on tops and bottoms.
         1) Full flush overlay, vertical match grain, Red Oak veneer doors and drawer fronts have a particleboard core with vertical grain Red Oak and Red Oak hardwood edging, 5/8" waterfall on sides, and 5/8" flat on tops and bottoms.
   4. Door and drawer hardware style
      a. Drawer and door pulls: AL-2: Stainless Steel rod design.
      b. Hinges:
         1) CP-1: Heavy-duty, institutional type, 5-knuckle hospital tipped, made from 0.083 inch thick Stainless Steel. Hinge is semi-concealed, 2 3/4 inches high and has off-set wings; each wing has 5 screw holes for the door leaf and 4 screw holes for the case leaf, two of which are slotted for adjustability. Hinges are attached with Euro screws.
      c. Latching Handle:
         1) CP: Latching handle CP LH-1 is chrome plated, 4 1/4 inches long and streamline in design. Handle operates with 1/4 turn. Double door cases have latching handles on the right door and dummy handles on the left door. A three-point

latching system provides a positive engagement at the top and bottom of the door with tapered aluminum rods, which pull the door snug when they engage plastic strike plates. The rods are 5/16 inch in diameter and move in nylon guides attached to the back of the door. The middle of the door is secured by a latch plate, which engages the side of the case, or latches behind the left door on cases with double doors.

d. Locking Handle:
    1) CP: Chrome plated locking handle is a latching handle with a lock mechanism incorporated into the handle head. On double door cases, the left door has a dummy handle, and the right door has the locking handle. Lock is laboratory grade with a 5-disc tumbler mechanism with a brushed chrome face. Tumblers and keys are brass, while the plug and cylinder is die cast zinc alloy. There are 500 key changes standard. Locks are keyed differently, master keyed and furnished with 2 keys per lock. Locks and corresponding keys are alpha-numerically coded for a quick match.

e. Locks: Removable core standards:
    1) CP: Lock CP SL-1 is laboratory grade, cylinder cam lock, with a 5-disc tumbler mechanism with a chrome plated face. Tumblers and keys are brass, while plug and cylinder is die cast zinc alloy. A 180-degree turn of the key moves the lock cam into, or out of, a slot cut to receive it. There are 500 key changes standard. Locks are keyed differently, master keyed and furnished with 2 keys per lock. Locks and corresponding keys are alpha-numerically coded for a quick match. Lock CP SL-1 is equipped with a removable core, keying control. With the use of a control key, the key core of the lock assembly can be removed and a new key core inserted, changing the entire locking system in a matter of minutes. Key cores can be held out of the lock assembly until the project is completed, removing the security risk of lost or stolen keys during installation and construction. Casework manufacturer can provide control keys and replacement cores as required. Locks are furnished only when specified.

f. Drawer slides:
    1) Drawer slides FS-1: Zinc plated, cold rolled steel, heavy-duty with a 100 lbs (45 kilograms) load capacity. They are equipped with heavy-duty ball bearing rollers for smooth effortless operation. Slides have automatic positive stops to prevent drawer's accidental removal but allow for quick removal without tools. Drawer slides are full extension.

B. Materials
1. Red Oak Lumber: Grade FAS or better, air-dried and kiln dried to 6 percent moisture content, then tempered to 7 to 8 percent prior to fabrication. Lumber exposed to view, is free of stains, splits, shakes, season checks and other similar defects. Other hardwoods are grade FAS or better, air dried to 6 percent moisture content, then tempered to 7 to 8 percent prior to fabrication. Other hardwoods are used in semi-exposed, or unexposed, areas and comply with NHLA grading for FAS or better lumber.
2. Red Oak Plywood: Plywood is plain sliced, book-matched Red Oak, select grade A-1, cross-banded, and has a veneer core. The 1 inch or 3/4-inch plywood is a minimum of 7-ply, 1/2 inch is a minimum of 5 ply, 1/4 inch is minimum of 3 ply, and 3/32 inch is 3-ply. Other hardwood plywood is sound grade, has a solid core and is suitable for semi-exposed or unexposed areas. All plywood shall be CARB Phase 1 compliant.
3. Hardboard used in drawer bottoms and unexposed backs, consists of super-refined wood fibers and chips, highly compressed into a hard, dense, [1/4] inch thick, homogeneous sheet, faced with wood grain pattern melamine on the exposed face. Physical properties: Average MOR is 5,000 lbs/sq inches (3.5 kgf/sq mm); density is 48 lbs/cu ft (0.6 kg/cu m); and MOE of [500,000] psi.

C. Fabrication:
1. Units and configurations designated for accessibility by users shall comply with ATBCB ADAAG (ADA standards).
2. Design, material and construction of casework, shelving and tables shall comply with SEFA

8 performance and resistance standards.

3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for its intended use.
4. ICI Base cabinets have a 2 1/4 inches by 1-inch, solid hardwood horizontal front top frame member and 2 1/8 inches by 1-inch, solid hardwood horizontal rear and side top frame members. Front intermediate rails are 3/4 inch by 2 1/2 inches solid wood. Back intermediate rails are furnished only when drawer separators are specified. Exposed exterior backs are 3/4-inch plywood. Cabinets with exposed interiors but unexposed exteriors have 1/4-inch plywood backs. Cabinets with unexposed interiors and exteriors have 1/4-inch-thick hardboard with wood grained melamine face backs. Exposed end panels are 3/4-inch plywood. Unexposed end panels are 3/4-inch hardwood plywood. End panels with unexposed interior and unexposed exterior are 3/4-inch hardwood plywood. Bottom, and dividers in cabinets with exposed interiors are 3/4-inch plywood; with unexposed interiors is 3/4-inch hardwood plywood. Adjustable shelves are epoxy powder coated 20-gauge steel. Shelves over 36” will have a hat channel reinforcement. Exposed edges of front top horizontal frame and intermediate rail members; end panels, bottom, and dividers are edged with 1/8-inch solid wood. Drawer separators, furnished only when specified, are 1/4-inch-thick hardboard with wood grained melamine face.
5. Cabinet construction is bored, doweled, dadoed, glued and screwed construction. Cabinets are enclosed without the use of common partitions. A full horizontal, mortise, tenon and glued, top frame is bored, doweled, glued, and reinforced with six (6) screws into the cabinet. Intermediate front rails and bottom rear horizontal parting rails are provided as required. Separators, where specified, are let into routed intermediate rails. Backs are recessed and encapsulated into dadoed end panels then screwed into the top and bottom case members. A standard enclosed toe space, 2-1/4 inches by 4 inches high, is provided, with toe rail bored, doweled and glued to end panels; however, casework cabinets, when in a library assembly such as a circulation desk, will have an enclosed toe space 2-1/4 inches deep by 6 inches high. Shelves are supported on heavy-duty, laboratory grade, metal shelf clips, which fit into two double rows of holes drilled 1-1/4 inches on centers, in the case end panels for maximum shelf adjustability.
6. Construction - Wall and Upper Cases: Wall and upper cases have a 1-inch plywood top and bottom panel Adjustable shelves are epoxy powder coated 20-gauge steel. Shelves over 36” will have a hat channel reinforcement. Backs are 1/4 inch finished plywood in cases with exposed interiors and 1/4-inch-thick hardboard with melamine face in cases with unexposed interiors. End panels in cabinets with exposed interiors are 3/4 inch finished plywood; end panels in cabinets with unexposed interiors are 3/4-inch hardwood plywood. Exterior hanger rails are 4 inches by 3/4-inch hardwood plywood.
7. Construction - Tall Cases: Top panels in tall cases with exposed interiors are 1 inch hardwood plywood; tall cases with unexposed interiors have top panels of 1 inch plywood. Bottom panels in tall cases with exposed interiors are 3/4-inch hardwood plywood; and unexposed interiors have 3/4-inch plywood. Interiors, whether exposed or unexposed, are stain color matched to the exterior finish. Adjustable shelves are epoxy powder coated 20-gauge steel. Shelves over 36” will have a hat channel reinforcement. Backs in tall cases with exposed interiors and exposed exteriors, are 1/4-inch hardwood plywood. Tall cases with unexposed interior or exterior backs have 1/4-inch hardboard melamine color stain matched to the interior. End panels in tall cases with exposed end panels have 3/4-inch hardwood plywood. End panels in cases with unexposed end panels have 3/4-inch plywood. All exposed edges of hardwood plywood components and plywood components are edged with 1/8-inch solid hardwood edging. Tall cases have two exterior hardwood plywood cross rails, 4 inches by 3/4 inch (102 mm x 19 mm). Tall cases are rigidly constructed, integral units with the strongest, most advanced joinery methods utilized of bored, doweled, dadoed, glued and screwed construction. Each case is completely enclosed without the use of common partitions and has flush construction with overlapping doors to provide a dust resistant interior. The top panel is bored, doweled and glued into end panels; and the bottom panel is bored, doweled and glued into end panels and glued

and screwed to the back. Additional back cross rails are provided as required. Backs are recessed and encapsulated into dadoed end panels and screwed to the top and bottom tall case members. An enclosed toe space 2-1/4 inch by 4 inches (57 mm by 102 mm) is provided with toe rail securely bored, doweled and glued to end panels and bottom panel. Adjustable shelves are supported on heavy-duty laboratory grade, twin pin plastic shelf clips, which fit into two rows of holes drilled 1-1/4 inches on centers in the end panels, for maximum shelf adjustability.

8. Drawer front is 3/4 inch thick. All squared edged styles drawer faces are screwed to the face of a full drawer box. Drawer box shall be 1 piece construction 20-gauge epoxy powder coated steel. In cabinets 24 inches or less in width, drawers have one pull. In cabinets over 24 inches wide, drawers have two pulls.
9. Construction - Hinged Doors:
    a. Hinged solid doors 48 inches or less in height, 3/4 inch thick and overlap the opening on all sides. Doors have one pull. Door has two heavy duty, institutional type, and 5-knuckle hinges. Doors are secured by a friction roller catch and a metal strike plate.
    b. Hinged solid doors, over 48 inches in height, are 3/4 inch thick and overlap the opening on all sides. Single doors and right door of double doors have a latching handle. A three-point latching system provides single doors and right door of double doors positive engagements at the top and bottom of the door with tapered aluminum rods, which engage plastic, strike plates and pull the door snug. The rods are 5/16-inch (0.31 inch) in diameter and move in nylon guides attached to the back of the door. The middle of the door is secured by a latch plate, which engages the side of the case, or latches behind the left door on cases with double doors and securely hold the door shut. Right door of double doors lap over the machined integral astragal on left door in lipped styles; square edged styles have an applied astragal on the left door. Plastic laminate style doors have particleboard core, and no astragal. Doors have four hinges. On double doors left door is additionally secured with two friction roller catches with metal strike plates.
10. Construction Book Shelving: Book shelving top panels are [3/4] inch plywood with a [2-1/2] inch high front facia of solid hardwood. Bottom panels in cases with exposed interiors are [1] inch plywood. Adjustable shelves are epoxy powder coated 20-gauge steel. Shelves over 36” will have a hat channel reinforcement. Backs are [1/4] inch plywood. End panels are [1] inch plywood. Exposed edges of end panels, dividers and shelves are edged with [1/4] inch solid wood. Intermediate panels are [1] inch hardwood plywood. Book shelving is rigidly constructed with full top and bottom frames bolted to end and intermediate panels. Back panels are encapsulated in grooves in end panels and top panel. Bookshelf units have adjustable shelves supported by heavy duty chrome plated steel pins recessed in shelf, [1-1/4] inch o.c.

D. Finishes
1. Wood Cabinets: Exterior and interior surfaces of cabinets receive the full finishing process consisting of baked on: specified NGR stain, two coats of protective moisture resistant sealer and two applications of a topcoat of clear catalyzed chemical resistant conversion varnish.
    a. Interior Surfaces: The unexposed interior surfaces of cupboards, wall cases, upper cases, and tall cases must match exterior color and receive stain (color coat), a protective coat of moisture resistant sealer, and two applications of a clear, catalyzed, chemical resistant conversion varnish topcoat.
    b. Other Surfaces: Unexposed surfaces such as unexposed end panels, unexposed backs, drawer sides and drawer bottoms are processed through standard finishing steps and receive a baked on protective coat of moisture resistant sealer, baked on clear catalyzed chemical resistant conversion varnish, but no stain (color coat).
    c. Finish shall comply with SEFA-8 resistance standard acceptable levels for casework surfaces. An independent 3rd party testing facility's written certification must be provided to establish that final finish has no more than three, SEFA-8 "Level 3" conditions.
    d. Any deviations from the specified finishing procedures will be considered defective

Work and rejected by the Architect.

E. Cabinet Hardware:
   1. Provide laboratory casework manufacturer's standard finish, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.
   2. Friction roller catch is zinc plated steel catch with a spring cushioned; polyethylene roller, and a metal strike plate. Screw mounted catches and strike plate have slotted holes for adjustability.
   3. Shelf clips are made from clear polycarbonate and are laboratory standard grade. Clips have double, 3/16-inch diameter pins and are equipped with shelf lock hold down tabs for 3/4 inch or 1-inch-thick shelves.

F. Countertops:
   1. Rhearesin is [1] inch thick, molded from a modified epoxy resin. Exposed edges and corners are radiused, and a drip groove is provided under surface in areas where sinks are installed. Curb is [4] inches high.
      a. Color: Granite.

G. Accessories:
   1. Burette Rods: 1/2-inch diameter, anodized aluminum, and either 18 inches or 24 incheslong. Rods are furnished with a tapered aluminum adapter to fit rod socket.
   2. Clamps: 1-inch square aluminum stock, with two, 3/4-inch diameter openings, at right angles to each other, bored through sides. Openings are for upright rods and crossbars, or Greenlaw Arms. Thumb screw into each end of the clamp; tighten against the rods to hold positions.
   3. Rod Sockets: Mushroom type, machined from a solid aluminum rod. Sockets are held in place by a heavy aluminum lock nut and washer.
   4. Upright Rods: 3/4-inch diameter, anodized aluminum, 36 inches long with a rounded top and a tapered bottom to fit rod sockets.
   5. Reagent Shelves: Provide as indicated, fabricated from same material as adjacent countertop, unless otherwise indicated.
   6. Pegboards: Clear acrylic, epoxy, or phenolic-composite pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.
   7. Safety Glass Monitor: Sturdy reinforced steel cabinet with double-locked doors. The monitor is equipped with eight shelves. A built-in germicidal lamp sanitizes the goggles/glasses between wearing and is fully shielded from the front to prevent accidental exposure. An automatic timer controls the sanitizing period. A 7-1/2” three-wire grounded cord with plug is mounted on the right end.
   8. Corrosive Cabinet 748-SC-8082, SciMatCo. This unit is designed to stand alone or stack up to two units high. Constructed of 1” thick multi-ply, exterior grade plywood finished in OSHA blue epoxy, corrosive resistant paint, and featuring a large “CORROSIVE” diamond decal on front of the two interlocking doors. Unit is equipped with one fixed polypropylene lined shelf and polypropylene lined floor, polypropylene padlock eye assembly, and nylon construction/assembly fasteners, but does not have a toe kick or top dispensing tray.
   9. Flammable Cabinet 748-SC-8080, SciMatCo: This unit is designed to stand alone or stack up to two units high. Constructed of 1” thick multi-ply, exterior grade plywood finished in bright yellow epoxy, corrosive resistant paint, and featuring a large “FLAMMABLE” diamond decal on front of the two interlocking doors. Unit is equipped with a continuous metal hinge, metal locking assembly, and one adjustable shelf with metal shelf brackets, but does not have a toe kick.
   10. Fire Blanket 299419-SE3006 Flinn Scientific Inc: Blanket measures 62” x 84”, and is naturally fire retardant, 100% wool. Heavy duty 22-gauge steel cabinet with red enamel finish, mounts on wall. Drop hinge door for quick access.

H. Fume Hoods:
   1. Air Foil, Air By-Pass.
   2. Fume Hood to be pre-wired to a single junction box on the top of hood.
   3. Fume Hood to be pre-plumbed from fixture to the valve. Piping to the valve by others.
   4. Service fixtures are front loaded type extruded brass with TFE-Coated silicone bronze stem and TFE packing for easy service. Services shall be color coded for easy recognition.

5. Vertical rising sash is counterbalanced to remain open in any position. Glass is 3/16” thick tempered safety glass in an epoxy-coated extruded aluminum and PVC frame. Sash Tracks are epoxy-coated steel.

I. Service Fixtures:
   1. Electrical Components, Devices, and Accessories shall be labeled to comply with NFPA 70, Article 100 and marked for its intended use.
   2. Provide service fixtures and fittings that comply with SEFA 7.
      a. Provide service fixtures and fittings that comply with recommendations of SEFA 7.
   3. Electrical Fixtures are 3-wire grounded, 20 A, 125V AC, with stainless steel cover plates and cadmium-plated steel boxes. Pedestal boxes are black, cast aluminum with conduit nipples and lock nuts. When specified, G.F.C.I., ground fault circuit interrupter fixtures are available. G.F.C.I. fixtures are 20 A, 125V AC, with black nylon faceplate.
      a. Receptacles: Comply with NEMA WD 1, NEMA WD 6, FS W-C-596, and UL 498. Duplex type, Configuration 5 20R
   4. Epoxy resin sinks are drop-in style, non-glaring black, and specially modified epoxy resins, molded in one solid piece or optimum physical and chemical resistance. Inside corners are coved and the bottom is dished to the outlet. Outlets are polypropylene with 1 1/2-inch NPS threads.
   5. Gas, Air and Vacuum Cocks: Ground key cocks, made from high grade, brass forgings, have integral ten serration, non-slip hose end. Wing or knob handle has color-coded index, is one-piece construction, precision ground, and lapped to fit cock chamber. Handle operates with a 1/4 turn and is spring-loaded for constant pressure and automatic take up. Provide needlepoint valves for high pressures and oxygen service where scheduled.
   6. Multiple Service Fixtures: Fixtures have one cold water faucet and two ground key cocks for gas, air, or vacuum services. Faucet has a rigid gooseneck, one four-arm or knob handle, and serrated hose nozzle. Vacuum breaker furnished when specified. Faucet with integral vacuum beaker is furnished, when specified. Ground key cocks have serrated non-slip hose end and color-coded, spring-loaded wing handles.
   7. Safety Station: Watersaver 893324-SSBF909
   8. Service Fixtures: Heavy-duty construction for water, gas, steam, or other services and specifically designed for laboratory use. Hot and/or cold Water Faucets are cast from red brass with color-coded index handles. Faucets have serrated hose nozzles, unless specified otherwise. Goosenecks are rigid. Fixture outlets are tapped 3/8-inch ([0.39] inch) I.P.S. for aerators, vacuum breakers, hose connections, or other accessories.
      a. Faucets with an integral vacuum breaker.
   9. Vacuum Breakers: Watts NLF-9, or comparable, vacuum breakers are brass with polished chrome plating, screw-in type with stainless steel working parts, and durable rubber diaphragm and disc. Vacuum breaker is for hot or cold faucet and has a primary valve with a soft disc that seat against mating part. The secondary check valve utilizes a soft disc to metal seating. Breaker is tapped 3/8-inch ([0.39] inch) N.P.T. Vacuum breaker is not intended for constant high pressures. Vacuum breakers shall be furnished for all faucets.

J. Patriot Tables:
   1. 2” square mild steel tubing welded into a frame assembly.
   2. Patriot Basic incorporates a welded in U channel stretcher at rear and on each side. Front to remain open.
   3. Patriot HD incorporates a 2” welded tube stretched at rear and at sides. Front to remain open.
   4. Patriot Basic to have telescoping legs, laser pierced, adjustable on 1” centers from sitting height to standing height. Legs are locked into position via 3/8 T6 black hex bolts.
   5. All tables to have heavy gauge welded double channel integral suspended cabinet rails.
   6. Tables to have heavy duty work surface mounting tabs fully welded in each corner of the table assembly
   7. Unless otherwise noted, the typical gauge of steel used in the construction of cases and related products shall be 18 GA. Exceptions listed below:
      a. 11 GA – table leg stretcher and leg rail support brackets, top mounting tabs, outer table legs, and outer suspended cabinet mounting channel.

b. 12 GA – inner Basic table tube leg.
c. 16 GA –table cross rails, apron rails and end rails

PART 3 EXECUTION

3.01 INSTALLERS

A. Installer Qualifications: For installation and maintenance of the field installation, a certified installer, with certification issued by the casework manufacturer, is required for this project.

3.02 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
   1. Walls and openings are plumb, straight and square
   2. Concrete floors level within 1/8-inch level per 10-foot run, non-accumulative, when tested with a straight edge in any one direction.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.03 COORDINATION

A. Laboratory equipment contractors shall furnish equipment to the building, setting in place, leveling and scribing to walls and floors. Furnish plumbing and electrical fixtures, including nipples and lock nuts needed to secure each fixture to the equipment.
B. Coordination with mechanical contractors who shall furnish, install and connect drain lines, service piping, vents, re-vents, in-line vacuum breakers, special plumbing fixtures, traps and tailpieces. Work to be completed through, under or along backs of working surfaces as required and complete final connection of services. Assemble, install and make final connections of service fixtures furnished by casework contractor, including service fixtures in fume hoods. Furnish, install and connect fume hood blowers, motors and all related ductworks. Furnish, install and connect service piping within fume hoods, including final connection.
C. Coordination with electrical contractor who shall furnish, install and connect electrical service lines, wire and conduit within the equipment, including reagent racks and fume hoods. Work to be completed through, under or along backs of working surfaces as required and complete final connection of services. Install and make final connections of electrical fixtures provided by casework installer, including electrical fixtures in fume hoods.

3.04 PREPARATION

A. Clean surfaces thoroughly prior to installation.
   1. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.05 INSTALLATION

A. Install casework in accordance with manufacturer's instructions.
   1. Installation of casework shall be plumb, level, true and straight, with no distortions.
   2. Use concealed shims as required.
   3. Where laboratory casework or equipment butts against other finished work, scribe and cut for an accurate fit.
   4. Lubricate operating hardware as recommended by the manufacturer.
B. Install countertop and edge surfaces in one plane with flush hairline seams. Locate seams where shown on Shop Drawings.
   1. Provide required holes and cutouts for service fittings as shown on Shop Drawings.
   2. Seal unfinished edges and cutouts in plastic-laminate countertops.
   3. Provide scribe moldings for closures at junctures of countertop, curb, and splash, with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
   4. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
C. Coordination with Mechanical, Plumbing and Electrical Contractors: Coordinate work of this Section with work of other Sections including but not limited to:
   1. Water and laboratory gas service fittings, piping, electrical devices, and wiring.
   2. Installation of fittings according to Shop Drawings and manufacturer's written instructions.
   3. Setting bases and flanges of sink and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material.
   4. Anchorage of fittings, piping, and conduit to laboratory casework, unless otherwise

indicated.

3.06 PROTECTION

A. Counter tops and ledges should be protected with 1/4-inch ribbed cardboard for the remainder of the construction process.
B. Protect installed products until completion of project.
C. Touch-up, repair or replace damaged products before Substantial Completion.
D. A qualified manufacturer representative shall demonstrate operation and maintenance procedures of the installed casework and equipment to the Owners personnel.

DIVISION 12 36 00 COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.
B. Wall-hung counters and vanity tops.

1.02 RELATED REQUIREMENTS

A. *Division 06 41 00* - Architectural Wood Casework.
B. *Division 22 4000* - Plumbing Fixtures: Sinks.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
B. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
C. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
D. PS 1 - Structural Plywood; 2009.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.
C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
D. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
E. Installation Instructions: Manufacturer's installation instructions and recommendations.
F. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
B. Solid Surfacing Countertops: Solid surfacing sheet over continuous substrate
   1. Flat Sheet Thickness: 1/2-inch, minimum.
   2. Solid Surfacing Sheet: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.

b. NSF approved for food contact.
c. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
d. Color and Pattern: As indicated on drawings.

3. Other Components Thickness: 1/2 inch, minimum.
4. Exposed Edge Treatment: Built up to minimum 1-1/2 inch thick edge. ; use marine edge at sinks
5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
6. Skirts: As indicated on drawings.

2.02 MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, CDX veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
C. Joint Sealant: Mildew-resistant silicone sealant, color to match adjoining surfaces.

2.03 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
1. Join lengths of tops using best method recommended by manufacturer.
2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
2. Height: 4 inches, unless otherwise indicated.

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before proceeding.
C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
B. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

DIVISION 12 48 13 ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Extruded aluminum entrance floor grilles.
B. Recessed floor mat and frame assemblies.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete
B. *Division 09 65 00* - Resilient Flooring

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data indicating properties of walk-off surface, component dimensions and recessed frame characteristics.
C. Shop Drawings: Indicate dimensions and details for recessed frame, patterns, color, edging and details.
    1. For recessed frames located within a dimensionally restricted area, show dimensions of space within which the frame will be installed.
D. Samples: Submit two samples, illustrating pattern, color, finish, and edging.
    1. Samples for Verification: 12-inch- (300-mm-) square assembled sections of floor mats. Show selected surface showing each finish and color.
E. Maintenance Data: Include cleaning instructions, stain removal procedures and maintaining floor mats.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain floor mats through one source from a single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the project site ready for use and fabricated in as large sections and assemblies as practical, in unopened original factory packaging clearly labeled to identify manufacturer.

1.06 FIELD SITE CONDITIONS

A. Field Measurements: Check actual openings for mats/grids by accurate field measurements before fabrication. Record actual measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delays of work.
B. Recessed Conditions: IMPORTANT: Coordination with *Division 03 00 00* Concrete specifications is required. For proper installation, the concrete recess must be flat and smooth throughout. If the recess is formed by a concrete contractor, the pour dimensions may require leveling grout to achieve the proper depth and a smooth finish. The final recess depth will match the specified product and must be field verified. For proper frame installation, the side walls of the concrete recess must also be straight and smooth. Inconsistencies with the recess and side walls must be remediated prior to product installation.
C. Coordinate integral installation of recessed frames and anchors with placing of concrete slab so frames are positioned accurately.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Entrance Floor Mats and Frames:
    1. Basis of Design: C-S Group; www.c-sgroup.com/entranceflooring.
    2. Nystrom, Inc: www.nystrom.com/sle.
    3. Pawling Corporation: www.pawling.com.
    4. Reese Enterprises, Inc: www.reeseusa.com.
    5. Balco: www.balcousa.com.
    6. Approved Equal.
    7. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 ENTRANCE FLOOR MAT AND FRAMES

A. Entrance Floor Mat: G3 PediTred LP - Shall be extruded 6105-T5 aluminum alloy with ½" deep multiple tread planks which are joined by an TPE hinge to comprise the overall grid length (traffic-direction). All material shall be perforated to allow drainage, unless otherwise specified. Heavy-duty powder coat finish. Units must withstand 750 lb. wheel loads (load applied to a solid 5" x 2" wide polyurethane wheel, 1000 passes without damage).

1. Recess Depth:3/4 inchesPer manufacturer.
2. Tread Surfaces: HD – MonoTuft HD™ Carpet shall meet CRI standard for good indoor air quality. Fibers shall include a minimum of 100, 12 mil monofilament fibers per square inch. Available in standard colors as offered by manufacturer. Each carpet fiber and monofilament shall be fusion-bonded to a rigid two-ply backing to prevent fraying and supplied in continuous splice-free lengths. Anti-static carpet fibers shall contain antimicrobial additive and be treated with Scotchgard® to reduce soiling. Carpet weight shall be 33-oz./yd².
3. Colors: As indicated on drawings.
4. Length in Direction of Traffic Flow: As specified on drawings.72 inches
5. Width Perpendicular to Traffic Flow: As indicated on drawings.
6. Frame: **LB - Level Base Frame** shall be a 3/4" (19.05mm) deep recessed frame in 6063-T6 aluminum alloy with a 1/4"(6.35mm) wide exposed surface. Black TPE filler trims shall be furnished as required, when standard 1 1/2" (38.1mm) tread spacing cannot be maintained. Installer shall use recommended latex screed to ensure level base. Frame color as specified in drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor opening for mats are ready to receive work.

3.02 PREPARATION

A. Mats: Verify size of floor recess before fabricating mats.
B. Vacuum clean floor.

3.03 INSTALLATION

A. Install frames to achieve flush plane with finished floor surface.
B. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.
C. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.
D. Defer installation of floor mats until Project is near Substantial Completion.

3.04 TOLERANCES

A. Maximum Gap Formed at Recessed Frame From Mat Size: 1/4 inch.

DIVISION 12 61 12 FIXED AUDITORIUM SEATING

Auditorium / theater-type seating is available in a variety of styles and designs for various assembly uses. The seating should meet the different expectations unique to each space in regard to aesthetics, comfort, seating maintenance, and durability. These projects will have varying budgets.

DESIGN: Shall comply with Americans with Disabilities Act (ADA) rules and regulations.

QUALITY ASSURANCE: Reference is made to a brand name as a base specification; however, this is not intended to limit competitive bidding. Products that are equal to or better than base specification will be given full consideration.

WARRANTY: Provide manufacturer’s warranty covering structural components and operating mechanisms, material and workmanship for a period of fifteen years from the date of final acceptance.

DIVISION 12 63 16 – GRANDSTAND SEATING SYSTEM – BLEACHERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

B. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this section.

1.02 SUMMARY

A. This section includes complete services to provide a permanent grandstand seating system of size and capacity indicated, and with features indicated on the drawings.

B. Related Sections
   1. Division 2 - Site Construction
   2. Division 3 – Concrete

C. Complete Scope of Work in this bid package includes the following:
   1. 10 Row x 129 ft Long Grandstand with 8/24 rise/run as shown on drawings
   2. Minimum seating capacity of 860 Gross Seats and 707 net seats
   3. Aluminum round tube understructure Designed with a L/200 Serviceability Criteria
   4. Mill aluminum structure finish
   5. Closed Aluminum Tread System
   6. Clear Anodized and Shop Blasted Slip Resistant Tread Finish
   7. Clear Anodized Aluminum Bench Seating
   8. Standard Color Powder Coated Finish Aluminum Risers
   9. Concrete Slab on grade
   10. Quality Assurance shall be provided as outlined in IBC Chapter 17. All associated special inspection and testing costs are included in this package.

1.03 REFERENCES

A. IBC 2012
B. AISC Steel Manual Thirteenth Edition
C. ACI 318-05
D. Aluminum Association Aluminum Design Manual 2010
E. ASTM E985
F. AWS D1.2

1.04 PERFORMANCE REQUIREMENTS

A. **Design Loads**

Dead Load	10 psf
Live Load	100 psf
Wind Speed	Design per local wind speeds & building codes
Sway Load	24 plf per row parallel to seatboards
Sway Load	10 plf per row perpendicular to seatboards
Seismic Load	Design per local seismic conditions
Guardrail Loads	50 plf distributed or 200 lb concentrated load applied in any direction

B. **Serviceability Requirements**
   1. Deflection shall be limited to 1/200 of the span for all structural members.
   2. Steel sizes, if listed in the bid documents, are minimum required sizes. Under no circumstance shall any sizes be reduced.

C. **Foundation Design**
   1. Foundations shall be designed based on the information in the geotechnical report that will be provided by the owner.
   2. Foundations shall be designed for bearing, overturning, and sliding for the following load cases as well as all applicable load cases in the building code using an allowable stress design.
      a. 1.0 DL + 1.0 LL + SWAY
      b. 0.6 DL + 1.0 WL
      c. 1.0 DL + 0.75 WL + 0.75 LL

      Soil bearing capacity to be verified by owner prior to placement of footings. Foundation sizes if shown on drawings will not be reduced under any circumstances.

1.05 SUBMITTALS

A. Bid Submittals - Copies of these submittals MUST be submitted with the bid. Failure to do so will result in an incomplete bid.
   1. Name of AISC certified steel fabricator that can be verified on the AISC website.
   2. Seating Plan
   3. Section Drawing
   4. Technical Proposal
   5. Slip resistant deck testing results.

B. Post-Bid Submittals
   1. Structural Calculations
   2. Full drawings including foundation plan, seating plan, section drawing, and details
   3. Report of special inspections completed during fabrication (if not AISC certified)

NOTE: Delays caused by required resubmittals due to noncompliance with the specification shall not extend any milestone date in the contract. The contractor is responsible for complying with all aspects of this specification.

1.06 SITE VISITATION

A. A visitation to the site seven days prior to bid date by a qualified representative of the grandstand manufacturer is mandatory. No allowance will be made after the contract award for any problems encountered which would have been discovered during the pre-bid visitation.

1.07 SITE REPRESENTATION

A. A qualified representative of the grandstand manufacturer must be onsite at all times during installation of the grandstand.

1.08 QUALITY ASSURANCE

A. AISC Certification: All structural steel shall be fabricated in an AISC certified plant that is certified "STD" at the time of the bid. The manufacturer shall be listed on AISC's website as a certified fabricator.

EXCEPTION: If grandstand manufacturer is NOT listed as AISC certified, they may opt to use another AISC certified fabricator OR make available to a Testing Agency (chosen by the owner) all records and documents which focus on general management, engineering, procurement, operations, and quality control. The manufacturer shall also allow said Testing Agency to examine actual fabrication work in the shop. All cost associated with testing by the Agency chosen shall be paid by the grandstand manufacturer. Chapter 17 of the IBC 2006 requires that certification of the manufacturer of steel be accomplished by an independent third party.

B. Experience: Manufacturer of grandstand system shall have a minimum of (5) years experience in fabrication of grandstand structures and shall, upon request, provide references to successful projects of similar size and project specific requirements.

C. Installation: Installation shall be performed by factory trained and certified representatives of the grandstand manufacturer.
   1. Installer shall have completed at least three installations of similar size. Documentation shall be provided upon request.
   2. Installation shall be performed using wage rates. Certified payroll & copies of payroll checks shall be provided upon request.

1.09 WARRANTY

A. Product shall be guaranteed for (5) years on the structure and (1) years on the finishes together with labor. Damage resulting from abnormal use, vandalism is not applicable.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. The specifications and plans are based on the grandstand system & features of Dant Clayton Corporation. Subject to compliance with all specified requirements, products shall be provided by either the basis of design manufacturer, or another approved manufacturer. Being listed as an approved manufacturer does not remove the requirements to comply with any portion of the drawings or specifications regardless of what is deemed a manufacturer's standard product. See below for the manufacturer approval process.
   1. Dant Clayton Corporation
   2. AASI
   3. National Recreation Systems

B. Additional manufacturers requesting to bid shall be approved by written addendum at least (7) days prior to bid date. Listing as an approved manufacturer does not remove the responsibility to meet all specifications. Additional manufacturers must submit physical product samples minimum of (7) days prior to bid for approval.
    1. Additional manufacturers shall submit product data and project references attesting to their ability to comply with the project drawings and specifications in all aspects.
    2. Such written documentation shall be received by the architect a minimum of 10 business days prior to the bid date.

2.02 PRODUCT COMPONENTS

A. Understructure shall consist of an open span I-Beam understructure.
    1. The column grid as shown in the documents shall not be altered. It has been specifically designed to coordinate with other site elements.
    2. Longitudinal bays may include angle cross bracing provided that it does not interfere with building entrances or vomitories.
    3. All beams and columns may be made of either wide flange or tube shapes.
    4. All steel shall be sized to support the most conservative of the loads in the table above, and the loads in the local building code. If sizes are shown in the drawing, they shall not be reduced for any reason.

B. Decking System shall be a Fully Closed Welded arrangement.
    1. The decking system shall be a Flush Face design. No channels or openings will be allowed in the vertical or horizontal surface.
    2. Footboards shall nest with adjacent planks via tongue and groove, and then each footboard shall be continuously welded to the adjacent footboard to limit deflection and minimize water penetration. The front footboard shall have a female groove that will receive the vertical riser board. The rear heel board shall have a vertically upturned portion to support the bottom of the upper riser and to shed water.
    3. The vertical riser shall interlock with the front footboard and will shingle over the upturned portion of the lower heel board to entirely close off the vertical face.
    4. The horizontal tread shall be sloped forward 1 degree to shed water off the front of the grandstand.
    5. The seat bracket shall attach directly to the steel understructure, and shall create a 'Double Lock' system to hold the footboards in place.
    6. Each individual footboard must be designed to support the resulting stress from a 120 plf live load.
    7. Decking joints shall be covered with a 4" aluminum joint cover
    8. The ends of the aluminum extrusions shall be covered with a one-piece aluminum angle end cap.
    9. All decking splices shall consist of an internal splice sleeve, and shall occur directly over a steel support.
    10. The decking system shall attach to the understructure using concealed clips.
    11. See Section 2.4.B for decking finishes.

C. Seating
    1. Bench seating shall be provided as shown in the drawings.
    2. Benches shall be a full 2" by 10" with a 1" radiused front edge for comfort.
    3. Seat Brackets shall connect directly to the steel understructure. No connections to aluminum channels are permitted.

D. Railing
    1. Guardrailing shall be provided to meet the height and loading requirements of all local building codes.
    2. Guardrail shall be a chain link fence system with posts consisting of a 2.8"x2" aluminum rectangular tube, or a minimum of L3x3x1/4 steel angle.
    3. Guardrail infill shall be 2" mesh 6-gauge vinyl-coated fabric chain link.

E. Ramps
    1. Ramps shall be configured as shown on drawings.
    2. Ramps shall have a maximum slope of 1:12, and shall have the same guard railing as the rest of the grandstand.

3. Ramps shall have a minimum post spacing of 3 ft and a maximum post spacing of 9 ft.
4. Material finishes shall match those on the grandstand.

F. Stair
1. Stairs shall consist of L3x3x1/4" legs with a sloping steel channel supporting the treads. Each tread shall be supported by a clip angle bolted to the sloping channel. Minimum vertical leg spacing is 3 ft. Maximum spacing is 9 ft.
2. Guardrail on the stairs shall match the guardrail on the stand.
3. Material finishes shall match those on the grandstand.

G. Hand & Grab Rails
1. Hand and Grab Rails shall be located in all areas required by building code.
2. Hand and Grab Rails shall be 1 15/16" O.D. extruded aluminum pipe.
3. Two-Line mid-aisle handrails shall be located in all interior aisles. All mid-aisle rails shall feature internal fittings for both lines of rail. External fittings are not permitted.

H. Closure
1. Vertical closure shall consist of an aluminum paneling system with sub framing integral with the grandstand.
2. Vertical Closure shall be located in the following areas:
a. Front of Grandstand
b. Field side of Ramps

2.03 MATERIALS

A. Structural Steel
1. All detailing, fabrication, and erection shall be completed in accordance with the AISC Steel Construction Manual 13th Edition. All fabrication shall be completed in an AISC certified facility as described in Para. 1.8 A.
2. Structural Steel shall be ASTM A572 multi-certified grade 50. Miscellaneous steel shall be ASTM A36.
3. Bolts & Nuts: All bolts 5/8" diameter and larger shall meet ASTM A325. All bolts 1/2" and small shall meet ASTM A307.
4. All welds shall conform to ANSI/AWS D1.1. Electrodes shall be E70xx
5. All steel finishes shall be per section 2.4

B. Aluminum
1. All footboards & seatboards shall consist of 6063-T6 aluminum alloy with minimum yield strength of 25 ksi.
2. All straight grab & hand rails shall consist of 6061-T6 aluminum alloy with minimum yield strength of 35 ksi.
3. All bent grab & hand rails shall consist of 6061-T4 aluminum alloy with minimum yield strength of 21 ksi.
4. All aluminum finishes shall be per section 2.4

C. Closure Panels
1. Closure panels shall be constructed of corrugated 6063-T6 extruded aluminum panels.

D. Concrete
1. All concrete work & materials shall comply with ACI 318.
2. Cast-in-place Concrete shall have a minimum compressive strength of 4,000 psi at 28 days.
3. All reinforcing steel shall be in accordance with ASTM A615 with a minimum yield strength of 60 ksi.

2.04 FINISHES

A. Structural Steel
1. All structural steel shall have a factory applied powder coat finish.
A. Powder for coating shall be a polyester-based thermal setting resin.
B. Powder coat system shall meet or exceed the following test requirements:
a. Direct Impact Resistance: ASTM D 2794-93, up to 160 in.-lbs.
b. Flexibility: ASTM D 522-93, Method B, equal to or less than a 1/4 inch mandrel.
c. Pencil Hardness: ASTM D 3363-93a, HB-2H
d. Crosshatch Adhesion: ASTM D 3359-97, Method B, 5B
e. Salt Spray Resistance: ASTM B 117, plus 1,000 hours

f. Humidity Resistance: ASTM D 2247, plus 1,000 hours

2. All structural steel fasteners shall be galvanized.

B. Aluminum

1. All footboards shall have a Powder Coated Stain & Slip Resistant Finish

a. All footboards shall have a Powder Coated Textured finish to resist oxidation.

b. All aluminum decking intended for use as a walking surface, including walkways, aisles, walking surfaces in seating sections, stairs, ramps, platforms, handicap areas, and landings, will exhibit a factory blasted slip resistant surface treatment intended to minimize the effects of wet conditions on pedestrian safety. The surface treatment shall be achieved through a metallic media blasting process in a controlled factory environment to ensure consistency.

c. Hand processes or sand blasting is strictly prohibited.

d. Untreated mill finish aluminum with raised “flutes” or “ribs” does not meet this requirement.

e. The surface treatment shall result in a minimum 0.80 coefficient of friction (COF), as recommended by the ADA Access Board for inclined surfaces, under both wet and dry conditions in all directions of travel, including parallel to any extruded raised “flutes” or “ribs”.

f. Independent test data is required to be submitted to verify that the minimum COF has been met. Such testing must have been performed with a tribometer capable of measuring COF under wet conditions, and as per the guidelines established in ANSI/NFSI B101.1 – Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Materials.

2. All Seatboards shall have a Clear Anodized finish.
3. All Riser boards shall have a Standard Color Powder Coated finish.
4. Powder coat system shall meet or exceed the following test requirements:
   a. Direct Impact Resistance: ASTM D 2794-93, up to 140 in.-lbs.
   b. Flexibility: ASTM D 522-93, Method B, 100% Pass
   c. Pencil Hardness: ASTM D 3363-93a, 3H-4H
   d. Crosshatch Adhesion: ASTM D 3359-97, Method B, 5B, 100% Pass
   e. Salt Spray Resistance: ASTM B 117, plus 1,000 hours
   f. Humidity Resistance: ASTM D 2247, plus 1,000 hours
5. All hand and Grab Rails shall be clear anodized
6. Vertical closure shall have a Standard Color Powder Coated finish.

C. Railing

1. Guardrail posts shall be either mill finish aluminum or galvanized steel angle.
2. Chain Link Infill shall have a black vinyl coating.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine all existing conditions with installer present for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

B. Prepare written report, endorsed by installer, listing conditions detrimental to performance of the work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install grandstand and all components according to manufacturer's written instruction and the approved shop drawings.

3.03 CLEANING

A. Clean all surfaces according to manufacturer's recommendations.
B. Use cleaning solutions and methods that do not damage the finishes or the adjacent surfaces.
C. Remove all metal burrs, sharp edges or other cutting, unsafe conditions.
D. Touch up finishes as recommended by manufacturer to the satisfaction of the architect.

DIVISION 12 63 17 – PRESS BOX

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish a prefabricated, 11'x42', modular press box equal to that provided by Dant Clayton Corporation, Louisville Kentucky.

1.02 RELATED WORK/RELATED SECTION

A. Grandstand / *Division 12 63 16*

1.03 SUBMITTALS

A. Bidders with any deviation from the specifications must comply with the following requirements seven (7) days prior to the bid opening.
   1. Plan view and wall section showing complete detail of layout, connection and trim detail.
   2. Schedule of Work Experience, including names of contacts and phone numbers; 10 jobs minimum within the last five (5) years.
   3. List of three (3) similar jobs within the past two (2) years – should owners (3 persons maximum) request a site visitation to these jobs, it will be at the bidder's expense.
   4. Resume including Corporate Officers, Sales Representatives, Technical Advisor, Project Manager, and Job site Superintendent.
   5. Project schedule, including phasing with other trades and designation for all tasks, milestone dates for drawing submittal, fabrication time, key material delivery dates and designated dates of installation.
   6. Shop drawings stamped and signed by a Professional Engineer licensed in the state of installation.

1.04 DESIGN CRITERIA

A. All material and workmanship shall be in accordance with the applicable state building code/ IBC current edition and NFPA.
B. All electric components shall be UL listed.
C. Design Loads:
   1. Live Load 100 psf Floor
   2. 50 psf Roof (w/ filming platform)
   3. Wind 20 psf on vertical surfaces
D. Design Classification
   1. Use Group: B, Construction Type: V-B

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in modular building construction with experience in manufacturing press boxes.
B. Engineer qualifications: The press box shall be approved by a registered professional engineer in the state the Press Box will exist in in.
C. Warranty: Press box shall be guaranteed for one (1) year against defective material or workmanship. Damage resulting from abnormal use or vandalism is not applicable.

PART 2 - PRODUCTS

2.01 FLOOR CONSTRUCTION

A. Bottom Board: 1/2" CCX foundation grade treated plywood. Industrial grade asphalt-based pint. Continuous aluminum vents on 8' centers.
B. Insulation: 6" R-19 fiberglass batts, with vapor barrier.
C. Joists: 2" x 6" #2 SYP, on 16" centers, longitudinal framing.
D. Decking: 3/4" Sturdifloor, underlayment grade, tongue and groove fir plywood, (Index24 in O.C.)

2.02 COVERING: 1/8" ARMSTRONG EXCELON VINYL COMPOSITION TILE.

A. Molding: 4" Thermoplastic rubber base molding by Roppe.

2.03 WALL CONSTRUCTION

A. Studs: 2" x 4", #2 or better SPF, on 16" centers, BOCA framing.
B. Bottom Plate: 2" x 4" #2 or better SPF.

2.04 TOP PLATES: (2) 2" X 4" #2 OR BETTER SPF.

A. Headers: As span and design load requires
B. Ceiling Height: 8'-2" x 8'-0", front to back.
C. Covering: 5/8" vinyl-faced gypsum panels, Class A, F.S.R.
D. Insulation: 3-1/2" R-13 fiberglass batts with vapor barrier.

2.05 SHEATHING: 1/2" CDX PLYWOOD.

A. Siding: 0.50 Mastic 8" vertical board and batten premium vinyl exterior siding color by owner.

2.06 ROOF CONSTRUCTION

A. Joists: 2" x 8", #2 SYP, 16" O.C. spacing.
B. Overhang: 15-1/2" over front wall; 6" over rear wall. .019 metal fascia with perforated vinyl soffit panels.
C. Ceiling: 5/8" type-x fire-rated gypsum board, taped and bedded with spray textured finish, Class A F.S.R.
D. Insulation: 6" R-19 fiberglass batts with vapor barrier.
E. Decking: 3/4" tongue & groove oriented strand board (Index 24" O.C.).
F. Covering: 060 single-ply EPDM rubber membrane, fully adhered.
G. 21'6" Steel Framed Canopy (Powder Coated Steel) With Integrated Anchors in the Roof.
H. Aluminum Roofing on Canopy – Standard Colors

2.07 WINDOWS – SLOPED FRONT PROFILE

A. Sloped front windows to improve sight lines and reduce glare.
B. Wintech "6000 Series Double Horizontal Slider window with extruded aluminum frames. AAMA LC-25 Structural rating with ¾" insulated Low-E, Argon Filled tempered Glass and removable insect screens. - Glazing Design Pressure = 22 psf minimum.
C. End Wall Aluminum Windows

2.08 DOORS

A. 18 ga insulated hollow metal door with 16 ga steel wrap around frames. Viewing window, vinyl weather stripping, aluminum threshold and lever handled lock set.
B. ELECTRICAL
C. Service Entrance Panel: Square D Q0124M100 with Main Disconnect; rated at 120/240v, single phase, 100-amp capacity.
D. Receptacles: Pass & Seymour 125 volt/15-amp duplex, spec-grade, along the rear wall. Wiremold 5400 Series two-piece multi-channel, dual voltage, non-metallic surface raceway along front wall below scorer's counter, outlets on 48" centers.
E. Lighting: Lithonia M232PC1S 4-ft. 2-tube fluorescent strips with low-glare parabolic diffusers.
F. Circuits: All branch circuit wiring is minimum #12 THHN encased in EMT thin wall conduit or MC Cable.

2.09 SCORERS' COUNTER

A. 20" deep x 1 ½" Clear Anodized finish aluminum countertop with rounded front nose. Mounted on brackets spaced a minimum of 32".

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation: Shall be handled directly by the manufacturer or by a factory certified installation subcontractor.
B. Erect per plans, shop drawings, and specifications.

3.02 CLEANING

A. Clean all surfaces according to manufacturer's recommendations.
B. Remove all packaging and construction debris.

3.03 RESPONSIBILITY OF GC/CM/OWNER

A. Site access
B. Final electrical hook-up

DIVISION 12 66 13 - TELESCOPING GYM SEATING

PART 1 GENERAL

Seating in gym shall consist of telescoping bleachers with plastic/polymer seats and integral aisle rails. If more than eight rows high, seating shall be powered.
DESIGN: Shall comply with Americans with Disabilities Act (ADA) rules and regulations.
QUALITY ASSURANCE: Reference is made to a brand name as a base specification; however, this is not intended to limit competitive bidding. Products that are equal to or better than base specification will be given full consideration.
BASE SPECIFICATION: Irwin Seating Company's telescopic bleachers with plastic seating on Model 4500 steel understructure
WARRANTY: Provide manufacturer's warranty covering material and workmanship for a period of ten years from the date of final acceptance.
OPTIONS: Provide the following options:

- Scorer's Table: Provide one 8' x 15" scorer's table.

REAR WALL COLUMN CUTOUTS: Provide custom bleacher cutouts at rear wall building columns (where they occur).
Shop drawings are required for bleachers.
Motorized Retractable Gym Bleachers with rows of seating made from high density polyethylene (HDPE) with two remote controllers required.
Demolition of existing bleachers and prepared for storage if school sees fit.
Installation of new motorized retractable plastic gym bleachers must meet all local & state code requirements to complete a functioning system.
Bleacher seats color will be determined.
Professional installation requires to ensure proper alignment and structural integrity and compliance with safety regulations.
Site preparation will ensure where the bleachers are installed is level and suitable foundation to support weight of bleachers when fully extended and to protect existing conditions.
Properly lubricate all moving parts like wheel, tracks and drive mechanism to maintain a smooth operation and prevent excessive ware.
Proper training for all operators.
Must follow latest MSCS Design Guidelines

1.01 SECTION INCLUDES

A. Telescoping bleachers.
B. Electric motor operators, controls, and internal wiring.

1.02 RELATED REQUIREMENTS

A. *Division 26 05 83* - Wiring Connections: Connection of electric motors and controls within the building as required for power operated telescopic seating.
B. *Division 26 27 26* - Wiring Devices: Key-operated wall switch(es).

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
B. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
C. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2023.
D. ASTM D2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics; 2022.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
F. NFPA 102 - Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures; 2021.
G. PS 1 - Structural Plywood; 2009.
H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
I. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.

2. Storage handling and requirements.
3. Installation methods.

C. Shop Drawings: Complete layout with dimensions, seat heights, row spacing and rise, aisle widths and locations, points of connection to substrate, assembly dimensions, and material types and finishes.
1. Provide drawings customized to this project.
2. Include Professional Engineer certification.
3. Wiring Diagrams: Show locations of motors, electrical wiring, and rough-in connections.
4. Graphics Layout Drawings: Indicate pattern of contrasting seat colors.

D. Selection Samples: For each material for which color selection is required, submit samples, 2 by 2 inches in size, illustrating colors and finishes available.

E. Operation and Maintenance Data: Manufacturer's operation and maintenance instructions, including annual inspection and maintenance and bi-annual inspection by a Professional Engineer or manufacturer factory service personnel.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. DESIGN LOAD CRITERIA (STRUCTURAL): International Building Code Standard: Comply with requirements of IBC / ICC 300, Chapter 4 "Standard for Bleachers, Folding and Telescopic Seating and Grandstands Assembly Seating," except where other requirements are indicated by the Architect/Owner.

B. Partial Loading Requirements: Telescopic seating governed by IBC 2018, ICC-300 2017, NFPA 102 2016 or NFPA 5000 2018 shall all comply with ASCE 2016, Section 4.3.3 Partial Loading.

C. Manufacturer Qualifications: Company specializing in telescopic seating manufacturing products specified in this section, with not less than three [3] years of documented experience in manufacturing telescopic seating.

D. Engineer Qualifications: Manufacturer to employ a registered, licensed Professional Engineer to certify that the equipment to be supplied meets or exceeds the design criteria of this specification.

E. Installation: Shall be handled directly by the manufacturer or by a factory certified installation subcontractor.

F. Product Liability: Certification of insurance coverage of not less than $5,000,000.

G. Welding Processes: To be performed by certified professional welding operators in accordance with American Welding Society – Certified Welding Fabricator, (AWS-CWF), D1,1 "Structural Welding Code-Steel."Welder Qualifications: Certified by AWS for the process employed.

H. Product Improvements: Equipment provided shall incorporate manufacturer's design improvements and materials current at time of shipment, provided that such improvements and materials are consistent with the intent of these specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store, in original packaging, under cover and elevated above grade.

1.07 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion. Replace parts that fail under normal use at no extra charge to Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Telescoping Bleachers:
1. Basis of Design: Irwin Telescopic Seating Company; Versatract with Infinity Seats: www.irwintelescopicseating.com/#sle.
2. Hussey Seating Company: www.husseyseating.com/#sle.
3. Approved Equal.
4. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 TELESCOPING BLEACHERS

A. Telescoping Bleachers: Factory assembled tiered benches that retract horizontally into depth approximately the same as a single row depth, with fixed seats mounted on leading edge of platforms.

1. Provide a design certified by a licensed Professional Engineer licensed in the State in which the Project is located.
2. Provide a design that has been in use for at least 5 years; submit documentation.
3. Design to comply with applicable requirements of NFPA 102 and requirements of code authorities having jurisdiction; where conflicts between requirements occur, comply with whichever is more stringent.
4. Design with solid fascia (riser) or seat fronts that conceal interior mechanisms when fully retracted, fitting tightly enough to prevent climbing up face; at front row provide key locked, hinged fascia (skirt) to cover gap between seat riser/fascia and floor.
5. Standard Extension: Top row fixed to floor, adjacent to wall under overhang, forward extension (away from wall); attachment to wall acceptable.
6. Configurations: As indicated on drawings.
7. Wheelchair Spaces: Permanent open spaces at locations indicated on drawings in compliance with ADA Standards.
8. Cutouts: Fit units to irregular wall surfaces, columns, pilasters, roof drain leaders, and other obstructions; take field measurements prior to fabrication.
9. Operation: Motor operated.

B. Design Loads: Design to withstand the following loading conditions:
1. Live Load on Structural Supports: 100 psf, minimum, of gross horizontal projection.
2. Live Load on Seats and Walking Surfaces: 120 pounds per linear foot.
3. Lateral Sway Stress on Structural Supports: 24 pounds per linear foot of seat plank.
4. Perpendicular Sway Stress on Structural Supports: 10 pounds per linear foot of seat plank.

C. Dimensions:
1. See drawings for overall dimensions.
2. Rise Per Row: 12 inches.
3. Row Depth: 31 inches.
4. Seat Height Above Tread: 6 inches.
5. Closed Depth: 4'-2 1/8"

D. Structural Supports: Steel or aluminum; manufacturer's standard wheeled carriages supporting each tier separately, with moving parts permanently lubricated and metal parts cushioned to prevent metal-to-metal contact during operation.
1. Design so that each row carriage so that it will individually support the design loads and is self supporting when fully assembled without dependence on platform panels or boards, seats, or fascia.
2. Welding: In accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M.
3. Bolting: Use lock-washers or locknuts.
4. Wheels: Minimum 5-inch diameter by 1-1/8 inch wide, with non-marring rubber tires; ball, roller, or oil-impregnated metal bearings; minimum of 2 wheels at each floor support.
5. Finish: Manufacturer's standard enamel or powder coating.
6. Row Locking: Automatically mechanically lock each carriage to adjacent carriages when fully extended.
7. Unlocking: Automatically unlock all rows before engaging retraction mechanism.

E. Motor Operation: Manufacturer's standard drive mechanism, using motor adequately sized for the purpose.
1. Provide UL listed electrical components and wiring.
2. Controls: Start, Stop, Forward, and Reverse in a single control unit.
3. Control Station: Removable plug-in low-voltage pendant station, with first-row plug-in location for each motor.
4. Limit Switches: Automatically stop operation when unit has reached fully open or fully closed position.
5. Provide all wiring internal to bleacher units, to junction box located where indicated; ensure that wiring is not energized except during operation.
6. Electrical Characteristics: 120V, single phase, 60 Hz.
7. Provide access to motor from front side of bleachers; a hinged front skirt or hinged section at least 30 inches wide is acceptable.

2.03 SEAT AND PLATFORM COMPONENTS

A. Seat/Fascia Assembly: Continuous, molded UV-stabilized high-density polyethylene plastic, seat minimum 1-inch thick, textured finish, homogeneous color throughout, color as selected from manufacturer's standard selection; approximately 18-inch-long sections independently removable with tongue-and-groove or rabbeted interlock at end joints.
   1. Shape: Ergonomically contoured, with internal ribs spaced for natural flexibility; rear edge cantilevered to provide toe room of not less than 3 inches; no openings to trap debris.
   2. Fire Retardance: Self-ignition temperature of 650 degrees F or greater when tested in accordance with ASTM D1929; smoke developed index of 450 or less, when tested in accordance with ASTM E84, or 75 or less when tested in thickness intended for use in accordance with ASTM D2843; and burning extent of 1 inch or less when tested in thickness intended for use in accordance with ASTM D635.
   3. Provide end caps of same material and finish on each exposed end.
   4. Supports: Internal steel reinforcement of each seat segment bolted to platform nose member; minimum two bolts per segment.

B. Platform, Tread, and Step Structure: Plywood continuously supported on front and rear with side joints tongue-and-grooved.
   1. Plywood: PS 1, 5-ply southern pine or polyethylene-overlaid Douglas fir or southern pine, Grade A-C.
   2. Plywood Thickness: 5/8-inch, minimum.
   3. Front (Nose), Rear, and Intermediate Supports: Steel channel or tube, hot-dipped galvanized.
   4. Provide end caps of same material and finish on each exposed end.
   5. Finish: High gloss clear urethane, both sides, unless polyethylene finished.
   6. Finish: Glued-down carpeting; 26 oz/sq yd olefin fiber with polypropylene backing; color as selected from manufacturer's standard selection.
   7. Nosings: Formed steel, minimum, G60/Z275 hot-dipped galvanized.
   8. Nosings: Extruded aluminum; clear anodized finish.
   9. At aisles provide permanently attached intermediate steps of same construction and finish.
   10. At bottom of aisles provide step in front of first riser, hinged to first platform to fold for storage.

2.04 HANDRAILS AND RAILINGS

A. Provide the following railings:
   1. Aisle Handrails: Single post folding railing segment mounted in center of aisle at every other row beginning at row 2.
   2. End of Row Guardrails: Self-storing, at open ends of sections beginning at row 2.
   3. Top Row Rear Guardrail: Non-removable self-storing, mounted behind rear seat with tubular supports, running full width of section.
   4. Height: 42 inches above adjacent platform or tread.
   5. Removable Railings: Provide steel post sockets attached to platform supports.

B. Design handrails and railings to withstand the following loads:
   1. Concentrated Load on Handrails: 200 pounds in any direction.
   2. Concentrated Load on Guardrails: 200 pounds in any direction along top rail.
   3. Live Load on Handrails: 50 pounds per linear foot, applied in any direction.
   4. Live Load on Guardrails:
      a. Horizontal: 50 pounds per linear foot, applied at the guardrail height.
      b. Vertical: 100 pounds per linear foot, applied vertically to top of guardrail.

C. Railing Construction: Round steel or aluminum pipe or tube, with formed elbows at corners and caps at ends of straight runs.
   1. Aluminum: 1.66 inches minimum outside diameter; natural anodized finish.
   2. Steel: 1-1/2-inch minimum outside diameter, with 11 gage, 0.12-inch minimum wall thickness; textured powder coat epoxy finish.
   3. Guardrail Infill: 9 gage, 0.1144-inch diameter steel wire woven chain link with twisted selvages, fastened to pipe panel frame.

2.05 ACCESSORIES

A. Fillers and Closures:
   1. Ends of Retracted Units: Plywood panels, finished to match platforms.
   2. Top Row: Provide seat level rear filler panels to close openings between top row seat and wall; finish to match platforms.
   3. Back of Units: Full width plywood panels, finished to match platforms, up to 8 feet above floor; vinyl curtains above to underside of top platform.
   4. Sides of Extended Units: Vinyl curtains.
   5. Vinyl Curtains: 18-ounce vinyl with grommets; color as selected from manufacturer's standard palette.

B. Aisle Lights: Low voltage shielded lighting, located at front of each intermediate step; 24 volts or less; including transformers and internal wiring.

C. Motion Monitor: Strobe light and warning horn rated at 150 dB, both of which operate continuously during movement of any section of bleachers; mount strobe light where it is clearly visible to entire bleacher installation.

D. Scorer's Table: 8 feet wide by 15 inches deep; relocatable to any row of any section without mounting brackets.

E. Fasteners: Provide hardware and fasteners in accordance with manufacturer92s recommendations.

F. Anchorage: As indicated on drawings; provide hardware in accordance with manufacturer92s recommendations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are consistent with those on the shop drawings.

B. Verify that electrical rough-ins have been installed and are accessible.

C. Do not begin installation until substrates have been properly prepared and area has been cleared of obstructions.

D. If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Do not field cut or alter seats, fascia, or structural members without approval.

C. Provide manufacturer's field representative to inspect completed installation.

3.04 ADJUSTING

A. Lubricate, test, and adjust each moving assembly to ensure proper operation in compliance with manufacturer's recommendations.

3.05 CLEANING

A. Clean exposed and semi-exposed assembly surfaces.

B. Touch up finishes on damaged or soiled areas.

3.06 CLOSEOUT ACTIVITIES

A. Demonstration and Training: Provide manufacturer's field representative to demonstrate to and train Owner's operating personnel in proper operation of equipment.
   1. Location: On site using installed equipment.
   2. Time: As agreed between Owner and Contractor.

3.07 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

DIVISION 14 24 00 – ELEVATORS: PASSENGER / FREIGHT / SERVICE / RESIDENTIAL / HYDRAULIC / TRACTION / MRL (MACHINE ROOM-LESS)

PART 1 GENERAL

Provide a hydraulic telescopic hole-less single or dual piston passenger elevator for accessibility. The capacity shall be 3500 lbs. with a speed of 150 FPM. The cab height shall be 8'-0". The hallway fixture is to be a key operated call with up/down buttons. Specify reduced voltage starting. Hydraulic Oil shall be biodegradable.
To supply and install a complete elevator system, meeting all applicable codes, standards, and performance requirements, including associated structural, electrical, and mechanical work necessary to deliver a fully functional elevator ready for use. (When applicable)
Elevator Type and Specifications:

- Type: [Passenger / Freight / Service / Residential / Hydraulic / Traction / MRL (Machine Room-Less)]
- Capacity: [e.g., 2,000 lbs., 3,500 lbs.]
- Speed: [e.g., 100 FPM, 350 FPM]
- Stops / Openings: [e.g., 1-4 stops, front and rear openings if required]
- Travel Distance : [e.g., 40+/- FT]
- Cab Dimensions: [Width x Depth x Height]
- Door Type: [e.g., center opening, single slide]
- Finish**:** [e.g., stainless steel cab, laminate panels, custom flooring]

MANUFACTURERS: Reputable manufacturer with a minimum of 20 years' experience in elevator system construction.

GUARANTEE: Elevator Contractor shall guarantee that the materials and workmanship of the apparatus installed by them under this specification are new and that they will correct defects not due to ordinary wear and tear or improper use of car which develop within one year from date of acceptance for all parts.

MAINTENANCE: Elevator Contractor shall provide twelve (12) months full contract service beginning at the date of Final Acceptance by Owner of each elevator. Service is to be provided on a monthly basis during regular working hours of regular working days except that emergency minor adjustment callback service shall be available at no additional cost 24 hours a day, 7 days a week.

TEMPORARY SERVICE: The elevator shall not be used for temporary service or for any other purposes prior to completion and acceptance by the Owner.

END USER DEMONSTRATION: A factory-authorized service representative shall perform a minimum of 8 hours training to the Owner's building and maintenance staff. Proper use, operation, and fire service test shall be demonstrated at this time.
The Contractor shall make a final check of the elevator operation with the Owner's maintenance personnel present. The Contractor shall ensure that the Owner has all necessary keys, manual, etc. as required in the specifications.

Specify stainless interiors with durable interior wall panels such as plastic laminate or equal. Specify LVT floor finish. Specify LED lighting. Specify phone line connection, floor numbering, LED floor lanterns at each floor, and call buttons for each floor.
Designers may consider Limited Use Limited Access (LULA) lifts in lieu of elevators should the condition and current adopted building codes allow. LULA lifts will be considered on a case-by-case basis.

Scope of Work

a. Design and Engineering/Project Delivery Method
- 100% Design-Build delivery Method for all Elevator work
- Coordinate with Architectural and Structural teams.
- Provide elevator shop drawings and submittals for approval.
- Ensure compliance with local building and elevator codes (e.g., ASME A17.1, ADA).

b. Supply and Delivery
- Supply elevator equipment including:

- Elevator machine, machine room, control systems & all associated components
- Cab/Car, doors, and frames
- Guide rails and pit equipment
- Hoistway (beam) and shaft equipment
- Fixtures (car and hall stations)
- Integration with fire alarm and building systems
- Elevator Sump system with Oil detection
- Oil Interceptor where applicable tied into Sanitary Sewer system
- Grease interceptor or automatic grease removal device for drainage from fixtures and equipment with grease-laden waste.
- HVAC for elevator machine room (if required).
- Elevator shaft work includes hoist beams, walls, framing, flat ledges, and any fire-rated construction
- Overhead structure above the shaft to support the elevator machinery and equipment
- Power supply including disconnecting switches and related electrical infrastructure
- Wiring and cabling necessary for communication and light fixtures in all cases
- Smoke and Heat Detection in all cases with fire safety system within the shaft and machine room
- Hydraulic oil shall be biodegradable (if necessary)
- Elevator barrel key install with 20 keys provided
- Cutting and patching floors, walls, ceilings etc., must be replaced if damaged in all cases
- Deliver equipment to site per schedule.

3. Installation
   - Installation of all elevator components.
   - Integration with fire alarm and building systems.
   - Provide all electrical connections (power, lighting, controls).
   - Coordination with MSCS and other trades.
4. Testing and Commissioning
   - Perform all required tests (load test, safety test).
   - Final adjustments and fine-tuning.
   - Coordinate inspections with local authorities (AHJ).
   - Obtain final certification for use.
   - Collaborate with JCI for monitoring
5. Documentation and Training
   - Provide O&M manuals and as-built drawings.
   - Train building staff on elevator operation and emergency procedures.
6. Warranty
   - Provide standard warranty for [typically 1 year] from date of final acceptance.
   - Include details for preventative maintenance during the warranty period.

Exclusions (if applicable)
- Construction of the elevator shaft or hoistway.
- Emergency generator or UPS.
- Fire alarm panel or building-wide systems.
- Structural modifications or enhancements outside elevator requirements.

Schedule
- Start Date:
- Completion Date:
- Milestones: [Insert key milestones such as delivery, start of installation, inspection dates]

1.01 SECTION INCLUDES

A. Machine room-less hydraulic passenger elevators as shown and specified.
B. Elevator work includes:
   1. Standard pre-engineered hydraulic passenger elevators.
   2. Elevator car enclosures, hoistway entrances and signal equipment.
   3. Operation and control systems.
   4. Jack(s).

5. Accessibility provisions for physically disabled persons.
6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
7. Materials and accessories as required to complete the elevator installation.

C. Elevator Maintenance Contract.

1.02 RELATED REQUIREMENTS

A. *Division 1* General Requirements: Meet or exceed all referenced sustainability requirements.
B. *Division 3* Concrete: Installing inserts, sleeves and anchors in concrete.
C. *Division 4* Masonry: Installing inserts, sleeves and anchors in masonry.
D. *Division 5* Metals:
   1. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
   2. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
E. *Division 9* Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
F. *Division 16* Sections:
   1. Providing electrical service to elevators, including fused disconnect switches where permitted. (note: fused disconnect switch to be provided as part of elevator manufacture product, see section 2.11 Miscellaneous elevator components for further details.)
   2. Emergency power supply, transfer switch and auxiliary contacts.
   3. Heat and smoke sensing devices.
   4. Convenience outlets and illumination in control room (if applicable), hoistway and pit.
G. *Division 22* Plumbing
   1. Sump pit and oil interceptor.
H. *Division 23* Heating, Ventilation and Air Conditioning
   1. Heating and ventilating hoistways and/or control room.
I. *Division 04 20 00* - Unit Masonry: Masonry hoistway enclosure; building-in and grouting hoistway door frames.
J. *Division 31 23 16* - Excavation: Excavation for cylinder casing, hydraulic lines, remote machine room, and _____.

1.03 REFERENCE STANDARDS

A. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.
B. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, Inclined Elevators, Limited-Use/Limited-Application Elevators, Private Residence Elevators, Escalators, Moving Walks, Dumbwaiters, and Material Lifts; 2023.
C. ASME QEI-1 - Standard for the Qualification of Elevator Inspectors; 2018.
D. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
E. ITS (DIR) - Directory of Listed Products; current edition.
F. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.
   1. Review schedule of installation, proper procedures and conditions, and coordination with related work.
   2. Review use of elevator for construction purposes, hours of use, scheduling of use, cleanliness of car, employment of operator, and maintenance of system.
B. Construction Use of Elevator: Elevator may be used for transport of construction personnel and materials in compliance with ASME A17.1.
   1. Enclose car with protective plywood on floor, walls, and ceiling.
   2. Provide temporary lighting.
   3. Provide control panel with manual and emergency operation.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Submit data on following items:

1. Show floors served, travel distances.
2. Signal and operating fixtures, operating panels, and indicators.
3. Car design, dimensions, layout, and components.
4. Car and hoistway door and frame details.
5. Electrical characteristics and connection requirements.

C. Shop Drawings: Include appropriate plans, elevations, sections, diagrams, and details on following items:
1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
4. Indicate electrical power requirements and branch circuit protection device recommendations.
5. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
6. Individual weight of principal components; load reaction at points of support.
7. Loads on hoisting beams and location of trolley beams.
8. Location and sizes of hoistway and car doors and frames.
9. Calculated heat dissipation of elevator equipment in machine room.
10. Applicable seismic design data; certified by a licensed Professional Structural Engineer.
11. Interface with building security system.
12. Electrical characteristics and connection requirements.

D. Samples: Submit samples illustrating car interior finishes and car and hoistway door and frame finishes in the form of cut sheets or finish color selection brochures.

E. Testing Agency's Qualification Statement.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Initial Maintenance Contract.

H. Maintenance Contract: Submit proposal to Owner for standard one year continuing maintenance contract agreement in accordance with ASME A17.1 and requirements as indicated, starting on date initial maintenance contract is scheduled to expire.
1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.

I. Operation and Maintenance Data:
1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
2. Operation and maintenance manual.
3. Schematic drawings of equipment, and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on hoistway apparatus.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with applicable code and as supplemented in this section.

B. Designer Qualifications: Design guide rails, brackets, anchors, and machine anchors under direct supervision of a licensed Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Perform structural steel design, fabrication, and installation in accordance with AISC 360, Specification for Structural Steel Buildings. Perform seismic design in accordance with applicable code.

D. Perform welding of steel in accordance with AWS D1.1/D1.1M.

E. Fabricate and install door and frame assemblies in accordance with NFPA 80.

F. Perform electrical work in accordance with NFPA 70.

G. Maintain one copy of each quality standard document on site.

H. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.

I. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than fifteen years of satisfactory experience installing elevators equal in character and performance to the project elevators.
J. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.
K. Inspection and testing: Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
    1. Arrange for inspections and make required tests.
    2. Deliver to the Owner inspection and testing reports upon completion and acceptance of elevator work.
L. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.
M. Products Requiring Fire Resistance Rating: Listed and classified by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
N. Products Requiring Electrical Connection: Listed and classified by UL (DIR) or testing agency acceptable to authorities having jurisdiction as suitable for the purpose indicated in construction documents.

1.07 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals for additional warranty requirements.
B. Provide manufacturer's warranty for elevator operating equipment and devices for one year from Date of Substantial Completion.

1.08 MAINTENANCE

A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.
    1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
    2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
    3. Manufacturer shall have a service office and full-time service personnel within a 100-mile radius of the project site.

1.09 WORK INCLUDED

A. Contractor shall provide the following in accordance with the requirements of the International Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Section 300 for hydraulic elevators. State or local requirements must be used if more stringent.
    1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.
    2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.
    3. Hatch walls require a minimum one hour of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.
    4. Elevator hoistways shall have barricades, as required.
    5. Install bevel guards at 75° on all recesses, projections or setbacks over 2” (4" for A17.1 2000 areas) except for loading or unloading.
    6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
    7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.
    8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
    9. The power unit shall be located in the pit, to reduce noise in the hoistway. Seal unit with hardtop and sound-deadening material. Include submersible design with dual muffler devices.

10. Access to the machinery space must be in accordance with the governing authority or code.
11. Provide an 8" x 16" cutout through machine room wall, for oil line and wiring duct, coordinated with elevator contractor at the building site.
12. All wire and conduit should run remote from either the hoistways or the machine room.
13. When heat, smoke or combustion sensing devices are required, connect to elevator machine room terminals. Contacts on the sensors should be sided for 120-volt D.C.
14. Install and furnish finished flooring in elevator cab.
15. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The Contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.
16. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
17. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
18. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
19. Fill and grout around entrances, as required.
20. Elevator sill supports shall be provided at each opening.
21. All walls and sill supports must be plumbed where openings occur.
22. Locate a light fixture and convenience outlet in pit with switch located adjacent to the access door.
23. A light switch and fused disconnect switch for each elevator should be located inside the machine room adjacent to the door, where practical, per the National Electrical Code (NFPA No. 70).
24. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway (or in the machine room).
25. For signal systems and power operated door: provide ground and branch wiring circuits, including main line switch. For car light and fan: provide a feeder and branch wiring circuits, including main line switch.
26. Provide supports, patching and recesses to accommodate hall button boxes, signal fixtures, etc.
27. Locate telephone and convenience outlet on control panel.

1.10 DELIVERY, STORAGE AND HANDLING

A. Manufacturing will deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.11 PROJECT CONDITIONS

A. Prohibited Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design - Hydraulic Elevators: ThyssenKrup Elevator; Endura Machine Room-Less Hydraulic Elevators: www.thyssenkruppelevator.com/#sle.
B. Other Acceptable - Hydraulic Elevator Manufacturers:
   1. Otis Elevator Company: www.otis.com/#sle.
   2. Schindler Elevator Corporation; Schindler 3300 Low-Rise MRL: www.schindler.com/#sle.
   3. Approved Equal.
C. Substitutions: See *Division 01 60 00* - Product Requirements.
D. Products other than Basis of Design are subject to compliance with specified requirements and prior approval of Architect. By using products other than Basis of Design, the Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

E. Source Limitations: Provide elevator and associated equipment and components produced by the same manufacturer as the other elevator equipment used for this project and obtained from a single supplier.

2.02 HYDRAULIC ELEVATORS

A. Hydraulic Elevator: Quantity One.
   1. Elevator Model: endura MRL Twinpost above-ground 3-stage
   2. Elevator Type: Hydraulic Machine Room-Less, Passenger
   3. Rated Capacity: 4500 lbs.
   4. Rated Speed: 150 ft./min.
   5. Operation System: TAC32H
   6. Travel: 32'-0"
   7. Landings: 3 total
   8. Openings:
      a. Front: 3
      b. Rear: 0
   9. Clear Car Inside: 5'-8" wide x 7'-9 1/2" deep
   10. Inside clear height: 7'-4" standard
   11. Door clear height: 7'-0" standard
   12. Hoistway Entrance Size: 4'-0" wide x 7'-0" high
   13. Door Type: Two-speed | RH Side opening
   14. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
   15. Seismic Requirements: Zone
   16. Hoistway Dimensions: 7'-8" wide x 9'-6 1/2" deep
   17. Pit Depth: 4'-0"
   18. Button & Fixture Style: Vandal Resistant Signal Fixtures
   19. Special Operations: None
   20. Digital Services: Remote Monitoring with Application Programming Interface (API) Integration ADA Phone - Code Compliant Cellular Connectivity A17.1 2019 Code - Enhanced Communications Smart Device Elevator Calling with occupant app API integration

2.03 CONTROLS

A. Controller: Shall be integrated in a hoistway entrance jamb. Should be microprocessor based, software oriented and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

B. Service Panel – to be located outside the hoistway in the controller entrance jamb and shall provide the following functionality/features:
   1. Access to main control board and CPU
   2. Main controller diagnostics
   3. Main controller fuses
   4. Universal Interface Tool (UIT)
   5. Remote valve adjustment
   6. Electronic motor starter adjustment and diagnostics
   7. Operation of pit motorized shut-off valve with LED feedback to the state of the valve in the pit
   8. Operation of auxiliary pump/motor (secondary hydraulic power source)
   9. Operation of electrical assisted manual lowering
   10. Provide male plug to supply 110VAC into the controller
   11. Run/Stop button

C. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

D. Emergency Power Operation: Fully automatic operation (Simplex 10D-4A) Upon loss of the normal power supply, building-supplied standby power is available to the elevator on the same wires as the normal power. Once the loss of normal power has been detected and standby

power is available, the elevator is lowered to a pre-designated landing and will open the doors. After passengers have exited the elevator, the doors are closed. At this time the elevator is automatically allowed to continue service using the building-supplied standby power.

E. Elevator Controls: Provide landing buttons and hall lanterns.
F. Door Controls:
    1. Program door control to open doors automatically when car arrives at floor.
    2. Render "Door Close" button inoperative when car is standing at dispatching terminal with doors open.
    3. If doors are prevented from closing for approximately ten seconds because of an obstruction, automatically disconnect door reopening devices, close doors more slowly until obstruction is cleared. Sound buzzer.
    4. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equipped with photo-electric light rays.
G. Landing Buttons: Stainless steel type, one for originating UP and one for originating DOWN calls, one button only at terminating landings; marked with arrows.
H. Landing Position Indicators: Illuminating white.
I. Car Direction Indicators: Illuminating white.
J. Interconnect elevator control systems with building fire alarm systems.
K. Provide "Firefighter's Operation" in accordance with applicable code. Designated Landing:
L. Additional Elevator Operation and Controls: See Section 14 2817.

2.04 EMERGENCY POWER

A. Arrange elevator operation to operate under emergency power when normal power supply fails.
B. Emergency Power Supply: Building emergency power; provide for emergency power characteristics and phase rotation same as for normal power. Provide transfer switches and auxiliary contacts. Install connections to power feeders.
C. Provide operational control circuitry for adapting the change from normal to emergency power.
D. Upon transfer to emergency power, advance one elevator at a time to a pre-selected landing, stop car, open doors, disable operating circuits, and hold in standby condition.
E. After the above operation has completed one complete cycle, operate one pre-selected elevator in normal operation from the emergency power supply. If the pre-selected car fails to operate, automatically select another car to operate.
F. Provide manual switch to override the automatic selection procedure.

2.05 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.
B. Sling: Steel stiles affixed to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.
C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.
D. Guide Shoes: Slide guides shall be mounted on top and bottom of the car.
E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on a steel template that is fastened to the pit floor or continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
F. A jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to ensure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless telescopic 3-stage. Two jacks piped together, mounted one on each side of the car with each having three telescopic sections designed to extend in a synchronized manner when oil is pumped into the Assembly. Each jack section will be guided from within the casing or the plunger assembly used to house the section. Each plunger shall have a high-pressure sealing system which will not allow for seal movement or displacement during the course of operation. A follower guide shall be furnished for the top of the lower two plungers and be guided by rollers running inside a steel guide channel which is firmly attached to the guide rail system. This plunger guide system shall maintain a stabilized support for the plunger sections. Each Jack Assembly shall have check valves built into the assembly to allow for automatically re-syncing the three plunger sections by moving the jack to its fully contracted position.

G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the landings and correct for overtravel or undertravel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.
H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper grade oil as specified by the manufacturer of the power unit.
I. Pit moisture/water sensor located approximately 1 foot above the pit floor to be provided. Once activated, elevator will perform “flooded pit operation”, which will run the car up to the designated floor, cycle the doors and shut down and trip the circuit breaker shunt to remove 3 phase power from all equipment, including pit equipment.
J. Motorized oil line shut-off valve shall be provided that can be remotely operated from the controller landing service panel. Also, a means for manual operation at the valve in the pit is required.

2.06 POWER UNIT

A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit located in the elevator pit consisting of the following items:
    1. NEMA 4/Sealed Oil reservoir with tank cover including vapor removing tank breather
    2. An oil hydraulic pump.
    3. An electric motor.
    4. Electronic oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.
B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.
C. Motor Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating – motors shall be capable of 80 starts per hour with a 30% motor run time during each start.
D. Control System: Shall be microprocessor based and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure.
E. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
    1. Relief valve shall be externally adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
    2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valves shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
    3. Check valves shall be designed to close quietly without permitting any perceptible reverse flow.
    4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
    5. Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.
    6. A secondary hydraulic power source (powered by 110VAC single phase) must be provided. This is required to be able to raise (reposition) the elevator in the event of a system component failure (i.e. pump motor, starter, etc.)
    7. Oil Type: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially

those operating in environmentally sensitive areas.

F. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.

2.07 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
   1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates, sight guards, and necessary hardware.
   2. Main landing door & frame finish: Stainless steel panels, no. 4 brushed finish.
   3. Typical door & frame finish: Stainless steel panels, no. 4 brushed finish.

B. Integrated Control System: the elevator controller to be mounted to hoistway entrance above 1st landing. The entrance at this level, shall be designed to accommodate the control system and provide a means of access to critical electrical components and troubleshooting features. See section 2.09 Control System for additional requirements.

C. At the controller landing, the hoistway entrance frame shall have space to accommodate and provide a lockable means of access (group 2 security) to a 3-phase circuit breaker. See section 2.11 Miscellaneous Elevator Components for further details.

D. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

E. Door Hanger and Tracks: Provide sheave type two-point suspension hangers and tracks for each hoistway horizontal sliding door.
   1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
   2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
   3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

F. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.08 CAR ENCLOSURE

A. Car Enclosure:
   1. Walls: Cab type TKAP, reinforced cold-rolled steel with two coats factory applied baked enamel finish, with applied vertical wood core panels covered on both sides with high pressure plastic laminate. Color: 8958 Bubble Art.
      a. Reveals and frieze: Stainless steel, no. 4 brushed finish
   2. Canopy: Cold-rolled steel with hinged exit.
   3. Ceiling: Downlight type, metal pans with suspended LED downlights and dimmer switch. Number of downlights shall be dependent on platform size with a minimum of six. The metal pans shall be finished with a stainless steel, number 4 brus
   4. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel.
   5. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
      a. Door Finish: Stainless steel panels: No. 4 brushed finish.
      b. Cab Sills: Extruded aluminum, mill finish.
   6. Handrail: Provide 2' flat metal bar on side and rear walls on front opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.
   7. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.
   8. Protection pads and buttons: Provide one set of vinyl protection pads with metal grommets for the project. Provide pad buttons on cab front(s) and walls.

B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station will give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.09 DOOR OPERATION

A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position

and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer-based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.

1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
   Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.
3. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.
4. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
5. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.
6. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.
7. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red-light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.10 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Swing return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Push buttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.

B. Emergency Communications System: Integral phone system provided.

C. Auxiliary Operating Panel:

D. Column Mounted Car Riding Lantern: Not required for this application.

E. Special Equipment: Not Applicable

F. Digital Services: Cloud-based IoT monitoring system comes standard with these options:

1. Remote Monitoring with Application Programming Interface (API) Integration
2. ADA Phone - Code Compliant Cellular Connectivity
3. A17.1 2019 Code - Enhanced Communications
4. Smart Device Elevator Calling with occupant app API integration

2.11 HALL STATIONS

A. Hall Stations, General: Vandal resistant buttons with center jewels which illuminate to indicate that a call has been registered at that floor for the indicated direction. Each button shall be provided with an internal automatic stop to prevent damage of switches that register the call. Provide 1 set of pushbutton risers. All fixtures shall be vandal resistant type.
   1. Provide one pushbutton riser with faceplates having a brushed stainless steel finish.
      a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Hall Position Indicator: An electronic dot matrix position indicator shall be provided and mounted for optimum viewing. As the car travels, its position in the hoistway shall be indicated by the illumination of the alphanumeric character corresponding to the landing which the elevator is stopped or passing. When hall lanterns are provided, the position indicator shall be combined with the hall lanterns in the same faceplate. Faceplates shall match hall stations. Provide at all typical landings.

D. Hall lanterns: A hall lantern with adjustable chime shall be provided at each landing and located adjacent to the entrance. The lanterns, when illuminated, shall indicate the elevator car that shall stop at the landing and in what direction the car is set to travel. When the car reaches a predetermined distance from the floor where it is going to stop, the corresponding hall lantern shall illuminate and the chime shall sound. The hall lantern shall remain illuminated until the car doors close in preparation for leaving the floor. Illumination of the arrow shall be with LED's. Faceplates shall match the hall station finish. Provide at all typical landings.

2.12 MISCELLANEOUS ELEVATOR COMPONENTS

A. Oil Hydraulic Silencer: Install an oil hydraulic silencer (muffler device) at the power unit location. The silencer shall contain pulsation absorbing material inserted in a blowout proof housing arranged for inspecting interior parts without removing unit from oil line.

B. Lockable three phase circuit breaker with auxiliary contact with shunt trip capability to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb and should be sized according to the National Electrical Code.

C. Lockable single phase 110V circuit breaker for cab light and fan to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb should be sized according to the National Electrical Code

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.

B. Verify that hoistway and pit are ready for work of this section.

C. Verify hoistway shaft and openings are of correct size and within tolerance.

D. Verify location and size of machine foundation and position of machine foundation bolts.

E. Verify that electrical power is available and of correct characteristics.

F. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 PREPARATION

A. Arrange for temporary electrical power for installation work and testing of elevator components.

B. Excavate for in-ground hydraulic cylinder casing and remove subsoil from site; see *Division 31 23 16* for additional requirements.

3.03 INSTALLATION

A. Coordinate this work with installation of hoistway wall construction.

B. Install system components and connect equipment to building utilities.

C. Provide conduit, electrical boxes, wiring, and accessories. *26 05 33.13 / 26 05 83*

D. Install hydraulic piping between cylinder and pump unit.

E. Mount machines, motors, and pumps on vibration and acoustic isolators.
   1. Place on structural supports and bearing plates.
   2. Securely fasten to building supports.
   3. Prevent lateral displacement.

F. Accommodate equipment in space indicated.

G. Install guide rails using threaded bolts with metal shims and lock washers under nuts. Compensate for expansion and contraction movement of guide rails.
H. Accurately machine and align guide rails, forming smooth joints with machined splice plates.
I. Bolt or weld brackets directly to structural steel hoistway framing.
J. Bolt brackets to inserts placed in concrete form work that will perform to four times the rated pull-out load.
K. Field Welds: Chip and clean away oxidation and residue with wire brush; spot prime surface with two coats.
L. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.
M. Fill hoistway door frames solid with grout; see *Division 04 20 00*.
N. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.
O. Machine Room Components: Clean and degrease; prime one coat, finish with one coat of enamel.
P. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.
Q. Adjust equipment for smooth and quiet operation.
R. Install elevator systems components and coordinate installation of hoistway wall construction.
    1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturers installation instructions and approved shop drawings.
    2. Comply with the National Electrical Code for electrical work required during installation.
S. Jack unit excavation: Drill or otherwise excavate below elevator pit construction as required to install the jack unit.
    1. Install casing for jack unit
    2. Provide HDPE jack protection system for all in ground jacks.
    3. Set casing for jack unit assembly plumb, and partially fill with water-settled sand, eliminating voids. Back fill depth shall be sufficient to hold the bottom of the jack in place over time.
T. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.
U. Alignment Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
V. Lubricate operating parts of system where recommended by manufacturer.

3.04 TOLERANCES

A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 and ASME A17.2.
B. Guide Rail Alignment: Plumb and parallel to each other within 1/8 inch.
C. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

3.05 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements for additional requirements.
B. Testing and inspection by regulatory agencies certified in accordance with ASME QEI 1 will be performed at their discretion.
    1. Schedule tests with agencies and notify Owner and Architect/Engineer.
    2. Obtain permits as required to perform tests.
    3. Document regulatory agency tests and inspections in accordance with requirements.
    4. Perform tests required by regulatory agencies.
    5. Furnish test and approval certificates issued by authorities having jurisdiction.
C. Perform testing and inspection in accordance with requirements.
    1. Inspectors shall be certified in accordance with ASME QEI-1.
    2. Perform tests as required by ASME A17.2.
    3. Provide at least two weeks written notice of date and time of tests and inspections.
    4. Supply instruments and execute specific tests.

D. Operational Tests:
   1. Perform operational tests in the presence of Owner and Architect/Engineer.
   2. Test single elevator system by transporting at least 6 persons up from main floor to top floor landings during a five minute period.
   3. At an agreed time, and the building occupied with normal building traffic, conduct tests to verify performance.
      a. Furnish event recording of each landing call registrations, time initiated, and response time throughout entire working day.
   4. Set period of time elevator takes to travel between typical floor landings at not more than 30 seconds.
      a. Measure time from moment doors start to close until car has stopped level at next floor landing and doors are opening.

3.06 ADJUSTING

A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.
B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch maximum from flush with sill.

3.07 CLEANING

A. See *Division 01 70 00* - Execution and Closeout Requirements for additional requirements.
B. Remove protective coverings from finished surfaces.
C. Clean surfaces and components in accordance with manufacturers' written instructions.

D. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.

3.08 CLOSEOUT ACTIVITIES

A. See *Division 01 78 00* - Closeout Submittals for additional submittals.
B. Demonstrate proper operation of equipment to Owner's designated representative.
C. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, cleaning and maintenance of each component.
D. Training: Train Owner's personnel on cleaning and operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.

3.09 PROTECTION

A. Do not permit construction traffic within car after cleaning.
B. Protect installed products until Date of Substantial Completion.
C. Touch-up, repair, or replace damaged products and materials prior to Date of Substantial Completion.

3.10 MAINTENANCE

A. Refer to *Division 01 70 00* - Execution and Closeout Requirements for additional requirements.
B. Provide Initial Maintenance Contract of elevator system and components in accordance with ASME A17.1 and requirements as indicated for 3 months from Date of Substantial Completion.
C. Submit proposal for continuation of Maintenance Contract in accordance with ASME A17.1 and requirements as indicated for installed elevator equipment.
D. Perform maintenance contract services using competent and qualified personnel under the supervision and direct employ of the elevator manufacturer or original installer.
E. Maintenance contract services shall not be assigned or transferred to any agent or other entity without prior written consent of Owner.
F. Examine system components monthly. Clean, adjust, and lubricate equipment.
G. Include systematic examination, adjustment, and lubrication of elevator equipment. Maintain hydraulic fluid levels. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original equipment. Replace wire ropes when necessary to maintain the required factor of safety.
H. Perform work without removing cars from use during peak traffic periods.
I. Provide emergency call back service for 24 hours a day/7 days a week throughout period of this maintenance contract.
J. Maintain an adequate stock of parts for replacement or emergency purposes and have

personnel available to ensure the fulfillment of this maintenance contract without unreasonable loss of time.

DIVISION 21 05 00 – FIRE SUPPRESSION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, fittings, sleeves, escutcheons, seals, and connections for sprinkler systems.

1.02 RELATED REQUIREMENTS

A. *Division 09 90 00* - Interior Painting: Preparation and painting of interior fire protection piping systems.

1.03 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
D. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2011.
E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).
F. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
G. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2013.
H. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
I. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
J. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.
K. AWWA C606 - Grooved and Shouldered Joints; 2011.
L. FM (AG) - FM Approval Guide; current edition.
M. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
N. UL (DIR) - Online Certifications Directory; Current Edition.
O. UL 262 - Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
P. UL 312 - Check Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide manufacturer's catalog information. Indicate valve data and ratings.
C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
D. Project Record Documents: Record actual locations of components and tag numbering.
E. Operation and Maintenance Data: Include installation instructions and spare parts lists.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Extra Valve Stem Packings: Two for each type and size of valve.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified in this section.
    1. Minimum three years' experience.
    2. Approved by manufacturer.
C. Comply with FM (AG) and UL (DIR) requirements.
D. Valves: Bear FM (AG) and UL (DIR) product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.
E. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place.
B. Provide temporary protective coating on cast iron and steel valves.
C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 PRODUCTS

2.01 FIRE PROTECTION SYSTEMS

A. Sprinkler Systems: Conform to NFPA 13.
B. Welding Materials and Procedures: Conform to ASME BPVC-IX.

2.02 GENERAL REQUIREMENTS

A. Sprinkler-based System:
   1. Comply with NFPA 13.
   2. See Section 21 1300.
B. Standpipe and Hose System:
   1. Comply with NFPA 14.
   2. See Section 21 1200.
C. Combined Sprinkler, Standpipe, and Hose System:
   1. Comply with NFPA 13 and NFPA 14.
   2. See Sections 21 1300 and 21 1200.
D. Welding Materials and Procedures: Comply with ASME BPVC-IX.
E. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

2.03 BURIED PIPING

A. Ductile Iron Pipe: AWWA C151/A21.51.
   1. Fittings: AWWA C110/A21.10, standard thickness.
   2. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR gasket.
   3. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.

2.04 ABOVE GROUND PIPING

A. Steel Pipe: black.
   1. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
   2. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
   3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
   4. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.
B. Ductile Iron Pipe: AWWA C151/A21.51.
   1. Fittings: AWWA C110/A21.10, standard thickness.
   2. Joints: AWWA C111/A21.11, SBR or vulcanized styrene-butadiene rubber gasket.
   3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

2.05 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm): Malleable iron, adjustable swivel, split ring.
B. Hangers for Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, clevis.
C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
D. Wall Support for Pipe Sizes to 3 inches (80 mm): Cast iron hook.
E. Wall Support for Pipe Sizes 4 inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
F. Vertical Support: Steel riser clamp.
G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.06 MECHANICAL COUPLINGS

A. Rigid Mechanical Couplings for Grooved Joints:
   1. Dimensions and Testing: Comply with AWWA C606.
   2. Minimum Working Pressure: 300 psig (2065 kPa).
   3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
   4. Housing Coating: Factory applied orange enamel.
   5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
   6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.
   7. Provide stops for direct stab installation without field assembly.
   8. Product:
      a. Victaulic Company: www.victaulic.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.07 GATE VALVES

A. Up to and including 2 inches (50 mm):
   1. Bronze body, bronze trim, rising stem, handwheel, solid wedge or disc, threaded ends.
B. Over 2 inches (50 mm):
   1. Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid rubber covered bronze or cast iron wedge, flanged ends.
C. Over 4 inches (100 mm):
   1. Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.

2.08 GLOBE VALVES

A. Up to and including 2 inches (50 mm):
   1. Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable rubber disc, threaded ends, with backseating capacity repackable under pressure.
B. Over 2 inches (50 mm):
   1. Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.09 BUTTERFLY VALVES

A. Bronze Body:
   1. Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115 volt AC.
B. Cast or Ductile Iron Body
   1. Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and internal tamper switch rated 10 amp at 115 volt AC.

2.10 CHECK VALVES

A. Up to and including 2 inches (50 mm):
   1. Bronze body and swing disc, rubber seat, threaded ends.
B. Over 2 inches (50 mm):
   1. Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends with automatic ball check.
C. 4 inches (100 mm) and Over:
   1. Iron body, bronze disc, stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

2.11 DRAIN VALVES

A. Compression Stop:
   1. Bronze with hose thread nipple and cap.
B. Ball Valve:
   1. Brass with cap and chain, 3/4-inch (20 mm) hose thread.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.
C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
C. Install piping to conserve building space, to not interfere with use of space and other work.
D. Group piping whenever practical at common elevations.
E. Sleeve pipes passing through partitions, walls, and floors.
F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
G. Inserts:
    1. Provide inserts for placement in concrete formwork.
    2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
    3. Provide hooked rods to concrete reinforcement section for inserts carrying pipe over 4 inches (100 m).
    4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
    5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
H. Pipe Hangers and Supports:
    1. Install hangers to provide minimum 1/2-inch (15 mm) space between finished covering and adjacent work.
    2. Place hangers within 12 inches (300 mm) of each horizontal elbow.
    3. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
    4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
    5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
    6. Provide copper plated hangers and supports for copper piping.
    7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
I. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
J. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
K. Do not penetrate building structural members unless indicated.
L. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
M. Escutcheons:
    1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
    2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
    3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.
N. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
O. Die-cut threaded joints with full-cut, standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
P. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.
Q. Provide gate valves for shut-off or isolating service.
R. Provide drain valves at main shut-off valves, low points of piping and apparatus.

3.03 CLEANING

A. Upon completion of work, clean all parts of the installation.
B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

DIVISION 21 05 23 – GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bronze butterfly valves with indicators.
B. Iron butterfly valves with indicators.
C. Check valves.
D. Bronze OS&Y gate valves.
E. Iron OS&Y gate valves.
F. NRS gate valves.
G. Indicator posts.
H. Trim and drain valves.

1.02 RELATED REQUIREMENTS

A. *Division 21 05 53* - Identification for Fire Suppression Piping and Equipment.
B. *Division 21 12 00* - Fire-Suppression Standpipes.
C. *Division 21 13 00* - Fire-Suppression Sprinkler Systems.
D. *Division 21 13 39* - Foam-Water Systems.
E. *Division 33 14 16* - Site Water Utility Distribution Piping.

1.03 ABBREVIATIONS AND ACRONYMS

A. EPDM: Ethylene-propylene diene monomer.
B. NRS: Non-rising stem.
C. OS&Y: Outside screw and yoke.
D. PTFE: Polytetrafluoroethylene.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Obtain valves for each valve type from single manufacturer.
   2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
B. Where listed products are specified, provide products listed, classified, and labeled by FM (AG), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.
C. Welding Materials and Procedures: Comply with ASME BPVC-IX.
C. Installer and Maintenance Contractor Qualifications:
   1. Company specializing in performing the work of this section with minimum five years documented experience.
   2. Trained and approved by manufacturer to design, install, test and maintain the equipment specified herein.
   3. Complies with manufacturer's certification requirements.
   4. Complies with manufacturer's insurance requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads and flange faces.
   3. Protect threads, flange faces, and weld ends.
   4. Set valves open to minimize exposure of functional surfaces.
B. Use the following precautions during storage:
   1. Maintain valve end protection and protect flanges and specialties from dirt.
      a. Provide temporary inlet and outlet caps.
      b. Maintain caps in place until installation.
   2. Store valves in shipping containers and maintain in place until installation.
      a. Store valves indoors and maintain at higher than ambient dew point temperature.
      b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.
C. Use the following precautions for handling:
   1. Use sling to handle large valves, rigged to avoid damage to exposed parts.
   2. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. UL Listed: Provide valves listed in UL (DIR) under following headings and bearing UL mark:
   1. Main Level: HAMV - Fire Main Equipment.
      a. Level 1: HCBZ - Indicator Posts, Gate Valve.
      b. Level 1: HLOT - Valves.
      c. Level 3: HLUG - Ball Valves, System Control.
      d. Level 3: HLXS - Butterfly Valves.
      e. Level 3: HMER - Check Valves.
      f. Level 3: HMRZ - Gate Valves.
   2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
      a. Level 1: VQGU - Valves, Trim, and Drain.
B. FM Global Approved: Provide valves listed in FM (AG) Approval Guide under the following headings:
   1. Automated Sprinkler Systems:
      a. Indicator posts.
C. ASME Compliance:
   1. ASME B16.1 for flanges on iron valves.
   2. ASME B1.20.1 for threads on threaded-end valves.
   3. ASME B31.9 for building services piping valves.
D. Comply with AWWA C606 for grooved-end connections.
E. Comply with NFPA 13 and NFPA 13R for valves.
F. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.
G. Valve Sizes: Same as upstream piping unless otherwise indicated.
H. Valve Actuator Types:
   1. Worm-gear actuator with handwheel for quarter-turn valves, except trim and drain valves.
   2. Handwheel: For other than quarter-turn trim and drain valves.
   3. Hand-lever: For quarter-turn trim and drain valves 2 NPS (50 DN) and smaller.

2.02 BRONZE BUTTERFLY VALVES WITH INDICATORS

A. UL 1091 and FM (AG) standard listing for indicating valves, (butterfly or ball type), Class Number 1112.
B. Minimum Pressure Rating: 175 psig (1200 kPa).
C. Body Material: Bronze.
D. Seat: EPDM.
E. Stem: Bronze or stainless steel.
F. Disc: Bronze with EPDM coating.
G. Actuator: Worm gear or traveling nut.
H. Supervisory Switch: Internal or external.
I. End Connections for Valves 1 NPS (25 DN) through 2 NPS (50 DN): Threaded ends.
J. End Connections for Valves 2-1/2 NPS (65 DN): Grooved ends.

2.03 IRON BUTTERFLY VALVES WITH INDICATORS

A. UL 1091 and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 112.
B. Minimum Pressure Rating: 175 psig (1200 kPa).
C. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
D. Seat: EPDM.
E. Stem: Stainless steel.
F. Disc: Ductile iron, nickel plated.
G. Actuator: Worm gear or traveling nut.
H. Supervisory Switch: Internal or external.
I. Body Design: Grooved-end connections.

2.04 CHECK VALVES

A. UL 312 and FM (AG) standard listing for check valves, Class Number 1045.
B. Minimum Pressure Rating: 175 psig (1200 kPa).
C. Type: Center guided check valve.
D. Body Material: Cast iron, ductile iron.
E. Center guided check with elastomeric seal.
F. Hinge Spring: Stainless steel.
G. End Connections: Flanged, grooved, or threaded.

2.05 BRONZE OS&Y GATE VALVES

A. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
B. Minimum Pressure Rating: 175 psig (1200 kPa).
C. Body and Bonnet Material: Bronze or brass.
D. Wedge: One-piece bronze or brass
E. Wedge Seat: Bronze.
F. Stem: Bronze or brass.
G. Packing: Non-asbestos PTFE.
H. Supervisory Switch: External.
I. End Connections: Threaded.

2.06 IRON OS&Y GATE VALVES

A. FM (AG), and UL 262 standard listing for fire-service water control valves (OS&Y snd NRS-type gate valves).
B. Minimum Pressure Rating: 175 psi (1,200 kPa).
C. Body and Bonnet Material: Cast or ductile iron.
D. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
E. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
F. Stem: Brass, bronze, or stainless steel.
G. Packing: Non-asbestos PTFE.
H. Supervisory Switch: External.
I. End Connections: Flanged.

2.07 NRS GATE VALVES

A. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
B. Minimum Pressure Rating: 175 psig (1200 kPa).
C. Body and Bonnet Material: Cast or ductile iron.
D. Wedge: Cast or ductile iron with elastomeric coating.
E. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
F. Stem: Brass or bronze.
G. Packing: Non-asbestos PTFE.
H. Supervisory Switch: External.
I. End Connections: Flanged.

2.08 INDICATOR POSTS

A. UL 789 and FM (AG) standard listing for indicator posts.
B. Type: Underground.
C. Base Barrel Material: Cast or ductile iron.

D. Extension Barrel for Adjustable Length Indicator Posts: Cast or ductile iron.
E. Cap: Cast or ductile iron.
F. Operation: Wrench.

2.09 TRIM AND DRAIN VALVES

A. Ball Valves:
1. Description:
a. Pressure Rating: 175 psig (1200 kPa).
b. Body Design: Two piece.
c. Body Material: Forged brass or bronze.
d. Port Size: Full or standard.
e. Seat: PTFE.
f. Stem: Bronze or stainless steel.
g. Ball: Chrome-plated brass.
h. Actuator: Hand-lever.
i. End Connections for Valves 1 NPS (25 DN) through 2-1/2 NPS (65 DN): Threaded ends.
j. End Connections for Valves 1-1/4 NPS (32 DN) and 2-1/2 NPS (65 DN): Grooved ends.

B. Angle Valves:
1. Description:
a. Pressure Rating: 175 psig (1200 kPa).
b. Body Material: Brass or bronze.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:
1. Description:
a. Pressure Rating: 175 psig (1200 kPa).
b. Body Material: Bronze with integral seat and screw-in bonnet.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc Holder and Nut: Bronze.
f. Disc Seat: Nitrile.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Confirm valve interior to be free of foreign matter and corrosion.
B. Remove packing materials.
C. Examine guides and seats by operating valves from the fully open position to the fully closed position.
D. Examine valve threads and mating pipe for form and cleanliness.
E. Examine mating flange faces for conditions that might cause leakage.
1. Check bolting for proper size, length, and material.
2. Verify gasket for size, defects, damage, and suitable material composition for service.
3. Replace all defective valves with new valves.

3.02 INSTALLATION

A. Comply with specific valve installation requirements and application in the following Sections:
1. *Division 21 13 00* for application of valves in wet and dry pipe, fire-suppression sprinkler systems.

B. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.
1. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in water supply connections and backflow preventer at potable water supply

connections.

D. Valves with threaded connections to have unions at equipment arranged for easy access, service, maintenance, and equipment removal without system shutdown.
E. Valves in horizontal piping installed with stem at or above the pipe center.
F. Position valves to allow full stem movement.
G. Install valve tags. Comply with *Division 21 05 53* requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

DIVISION 21 05 48 - VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

1.01 GENERAL

1.02 SECTION INCLUDES

A. Seismic snubber assemblies.
B. Seismic restraints for suspended components and equipment.

1.03 RELATED REQUIREMENTS

1.04 REFERENCE STANDARDS

1. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data:
   1. Provide manufacturer's product literature documenting compliance with specified requirements.
   2. Include seismic rating documentation for each restraint component accounting for horizontal, vertical, and combined loads.
C. Shop Drawings:
   1. Provide schedule of vibration isolator type with location and load on each.
   2. Fully dimensioned fabrication drawings and installation details for housekeeping pads, bases, member sizes, attachments, and supported equipment.
   3. Include auxiliary motor slide bases and rails, base weights, concrete weights, equipment static loads, and support points.
   4. Include selections from prescriptive design tables that indicate compliance with the applicable building code.
   5. Clearly indicate the load and capacity assumptions selected. Include copies of any calculations.
   6. Include the calculations that indicate compliance with the applicable building code for seismic controls and the manufacturer's requirements.
   7. Include the seal of the Professional Structural Engineer registered in Tennessee on the drawings and calculations which at a minimum include the following:
      a. Seismic Restraint Details: Detailed drawings of seismic restraints and snubbers including anchorage details that indicate quantity, diameter, and depth of penetration, edge distance, and spacing of anchors.
      b. Equipment Seismic Qualification Certification: Certification by the manufacturer or responsible party that each piece of equipment provided will withstand seismic force levels as specified in the applicable building code for seismic controls.
         1) Basis for Certification: Indicate whether certification is based on actual testing of assembled components, on calculations, or on historic data.
         2) Indicate equipment is sufficiently durable to resist design forces and or remain functional after the seismic event.
      c. Dimensioned outline drawings of equipment identifying center of gravity, locations, and provisions for mounting and anchorage.
      d. Detailed description of the equipment anchorage devices on which the certifications are based.
D. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

1.06 QUALITY ASSURANCE

A. Perform design and installation in accordance with applicable codes.
B. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and registered and licensed in Tennessee.
C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
D. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience.
E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section. See Section 01 4533 - Code-Required Special Inspections for additional requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. AFCON: www.afcon.org.
B. PHD Manufacturing, Inc: www.PHD-mfg.com.
C. TOLCO: www.tolco.com.
D. Substitutions: See *Division 01 60 00* - Product Requirements.
E. SEISMIC SNUBBER ASSEMBLIES
F. Products to be listed in accordance with the requirements of NFPA 13.
G. Directional External:
    1. Application: Minimum three (3) snubbers are required for each equipment installation, oriented properly to restrain isolated equipment.
    2. Construction: Interlocking steel construction attached to the building structure and equipment in a manner consistent with anticipated design loads.
    3. Performance: Equipment movement at each snubber location limited to a maximum of
        a. inches in any direction without significantly degrading the vibration isolation capability of the isolator during normal operating conditions.
    4. Resilient Pad: Minimum 0.25 inch (6.35 mm) thick cushions any impact and prevents metal-to-metal contact.
H. Lateral External:
    1. Application: Minimum three (3) snubbers are required for each stable equipment installation, oriented properly to restrain isolated equipment laterally where uplift forces are zero or addressed by other restraints.
    2. Construction: Steel construction attached to the building structure and equipment in a manner consistent with anticipated design loads.
    3. Performance: Equipment movement at each snubber location limited to a maximum of
        a. inches in any direction without significantly degrading the vibration isolation capability of the isolator during normal operating conditions.
    4. Resilient Pad: Minimum 0.25 inch (6.35 mm) thick cushions any impact and prevents metal-to-metal contact.
I. Omni Directional External:
    1. Application: Minimum four (4) snubbers are required for each stable equipment installation, oriented properly to restrain isolated equipment in lateral directions.
    2. Construction: Steel construction attached to the building structure and equipment in a manner consistent with anticipated design loads.
    3. Performance: Equipment movement at each snubber location limited to a maximum of
        a. inches in any direction without significantly degrading the vibration isolation capability of the isolator during normal operating conditions.
    4. Resilient Pad: Minimum 0.25 inches (6.35 mm) thick cushions any impact and prevents metal to metal contact.
J. Horizontal Single Axis External:
    1. Application: Minimum four (4) snubbers are required for each stable equipment installation, oriented properly to restrain isolated equipment in lateral directions where uplift forces are zero or addressed by other restraints.
    2. Construction: Steel construction attached to the building structure and equipment in a manner consistent with anticipated design loads.

3. Performance: Equipment movement at each snubber location limited to a maximum of
    a. inches in any direction without significantly degrading the vibration isolation capability of the isolator during normal operating conditions.
4. Resilient Pad: Minimum 0.25 inch (6.35 mm) thick cushions any impact and prevents metal-to-metal contact.

2.02 SEISMIC RESTRAINTS FOR SUSPENDED COMPONENTS AND EQUIPMENT

A. Products to be listed in accordance with the requirements of NFPA 13.
B. Cable Restraints:
    1. Wire Rope: Steel wire strand cables sized to resist seismic loads in lateral directions.
    2. Protective Thimbles: Eliminates potential for dynamic cable wear and strand breakage.
    3. Size: Based on the lesser of cable capacity or anchor load taking into account bracket geometry.
    4. Connections:
        a. Use overlapping wire rope U clips, cable clamping bolts, swaged sleeves or seismically rated tool-less wedge insert lock connectors.
        b. Internally brace clevis hanger bracket cross bolt to prevent deformation.
    5. Vertical Suspension Rods: Attach required bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.
C. Rigid Restraints:
    1. Structural Element: Sized to resist seismic loads in lateral directions and carry both compressive and tensile loading.
    2. Size: Based on the lesser of cable capacity or anchor load considering bracket geometry.
    3. Connections: Internally brace clevis hanger bracket cross bolt to prevent deformation.
    4. Static Support System: Anchorage capable of carrying additional tension loads generated by the vertical component of the rigid brace compression which is additive to any static load requirements on the system.
    5. Vertical Suspension Rods: Attached required bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions.
B. Comply with the requirements of NFPA 13.
C. Bases:
    1. Set steel bases for one inch clearance between housekeeping pad and base.
    2. Set concrete inertia bases for 4 inches (101.6 mm) clearance between housekeeping pad and base.
    3. Adjust equipment level.
D. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
E. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
F. Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.
    1. Up to 4 Inches Pipe Size: First three points of support.
    2. 5 to 8 Inches Pipe Size: First four points of support.
    3. 10 inches (254 mm) Pipe Size and Over: First six points of support.
    4. Select three hangers closest to vibration source for minimum 1.0 inch (25.4 mm) static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.02 INSTALLATION - SEISMIC

A. Comply with the following:
    1. Install in accordance with manufacturer's instructions.
B. Provide end of line restraint.
C. Seismic Snubbers:
    1. Install on all isolated equipment.
    2. Provide minimum of four seismic snubbers located close to isolators.

3. Snub equipment designated for post-disaster use to 0.05 inch (1.27 mm) maximum clearance.
4. Snub all other equipment between 0.15 inch (3.81 mm) and 0.25 inch (6.35 mm) clearance.

D. Piping:
1. Provide seismic bracing.
2. Provide supports, braces, and anchors to resist gravity and seismic design forces.
3. Provide flexible connections between floor mounted equipment and suspended piping; between unbraced piping and restrained suspended items; as required for thermal movement; at building separations and seismic joints; and wherever relative differential movements could damage pipe in an earthquake.
4. Brace every run 5.0 feet (152.4 cm) or more in length with two transverse and one longitudinal bracing locations.
5. Pipes and Connections Constructed of Ductile Materials (ductile iron, steel, welded or screwed connections):
   a. Provide transverse bracing at spacing not more than 40.0 feet (1219.2 cm) on center.
   b. Provide longitudinal bracing at spacing not more than 80.0 feet (2438.4 cm) on center.
6. Provide lateral restraint for risers at not more than 30 feet (914.4 cm) on center or as required for horizontal runs, whichever is less.
7. Piping Explicitly Exempt from Seismic Bracing Requirements:
   a. Provide flexible connections between piping and connected equipment.
   b. Install piping such that swinging of the pipes will not cause damaging impact with adjacent components, finishes, or structural framing while maintaining clear horizontal distance of 67 percent of the hanger length between subject components.
   c. Provide swing restraints as required to control potential impact due to limited space between subject components.
8. Use of proprietary restraint systems with a certificate of compliance, verified and listed by an accredited inspection body is acceptable (pending shop drawing approval), as an alternative to project specific seismic bracing design.
9. Re-use of Existing Hangers:
   a. Unless otherwise shown on the drawings, it is assumed all hangers supporting new piping, located at a seismic brace, will be new.

E. Floor and Base-Mounted Equipment, Vibration Isolated Equipment and associated Vibration and Seismic Controls for Connections:
1. Install equipment anchorage items designed to resist seismic design force in any direction.
2. Install vibration and seismic controls designed to include base and isolator requirements.
3. Provide flexible connections between equipment and interconnected piping.
4. Provide isolators and restraints designed for amplified code forces and with demonstrated ability to resist required forces including gravity, operational and seismic forces.
5. Where equipment is not designed to be point loaded, provide base capable of transferring gravity and seismic demands from equipment to isolator base plate anchorage.
6. Where concrete floor thickness is less than required for expansion anchor installation, install through bolt in lieu of expansion anchor.
7. Where timber/wood floor or other substrate is inadequate for installation of lag bolts, screws or other mechanical fasteners, install supplemental framing or blocking to transfer loads to structural elements.

F. Wall mounted Mechanical Equipment:
1. Provide support and bracing to resist seismic design force in any direction.
2. Install backing plates or blocking as required to deliver load to primary wall framing members.
3. Anchoring to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads is not permitted.

3.03 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Inspect isolated equipment after installation and submit report. Include static deflections.
C. Perform testing and inspections of the installation in accordance with Code-Required Special Inspections.

DIVISION 21 05 53 - IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.
B. Tags.
C. Stencils.
D. Pipe markers.
E. Ceiling tacks.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
D. Product Data: Provide manufacturers catalog literature for each product required.
E. Samples: Submit two labels of each proposed type.
F. Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.
G. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Automatic Controls: Tags.
B. Control Panels: Nameplates.
C. Instrumentation: Tags.
D. Major Control Components: Nameplates.
E. Piping: Tags.
F. Pumps: Nameplates.
G. Relays: Tags.
H. Small-sized Equipment: Tags.
I. Valves: Nameplates and ceiling tacks where above lay-in ceilings.

2.02 NAMEPLATES

A. Manufacturers:
   1. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   2. Seton Identification Products: www.seton.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.
B. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch (6 mm).
   3. Background Color: Black.
   4. Thickness: 1/8 inch (3 mm).
   5. Plastic: Comply with ASTM D709.

2.03 TAGS

A. Manufacturers:
   1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
   2. Brady Corporation: www.bradycorp.com.
   3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   4. Seton Identification Products: www.seton.com.
   5. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2-inch (40 mm) diameter.
C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2-inch (40 mm) diameter with smooth edges.
D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

A. Manufacturers:
   1. Brady Corporation: www.bradycorp.com.
   2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   3. Seton Identification Products: www.seton.com.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Stencils: With clean cut symbols and letters of following size:
   1. 3/4 to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
   2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
   3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.
   4. 8 to 10 inch (200-250 mm) Outside Diameter of Insulation or Pipe: 24 inch (600 mm) long color field, 2-1/2 inch (65 mm) high letters.
   5. Over 10 inch (250 mm) Outside Diameter of Insulation or Pipe: 32 inch (800 mm) long color field, 3-1/2 inch (90 mm) high letters.
   6. Equipment: 2-1/2 inch (65 mm) high letters.

2.05 PIPE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradycorp.com.
   2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   3. Seton Identification Products: www.seton.com.
   4. MIFAB, Inc.: www.mifab.com..
   5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Color: Comply with ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

E. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil, 0.004 inch (0.10 mm) thick, manufactured for direct burial service.

F. Color code as follows:
   1. Fire Quenching Fluids: Red with white letters.

2.06 CEILING TACKS

A. Manufacturers:
   1. Craftmark: www.craftmarkid.com.
   2. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Description: Steel with 3/4-inch (20 mm) diameter color coded head.

C. Color code as follows:
   1. Piping: Not required.
   2. Sprinkler Valves: Red.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.

F. Use tags on piping 3/4-inch (20 mm) diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
G. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

DIVISION 21 11 00 - FACILITY FIRE-SUPPRESSION WATER SERVICE PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water pipe.
B. Valves.
C. Fire department connections.
D. Private fire hydrants.
E. Water meters.
F. Polyethylene jacketing (encasement).
G. Accessories.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete.
B. *Division 21 05 00* - Common Work Results for Fire Suppression.
C. *Division 21 13 00* - Fire-Suppression Sprinkler Systems.

1.03 PRICE AND PAYMENT PROCEDURES

A. Pipe and Fittings: By the linear foot (meter). Includes hand trimming excavation, pipe and fittings, bedding, concrete thrust restraints, connection to building service piping, and to municipal utility water source.
B. Valves: By the unit. Includes valves, fittings, and accessories.
C. Hydrant: By the unit. Includes hand trimming excavation, gravel sump, hydrant, valve, connection, and accessories.

1.04 REFERENCE STANDARDS

A. ASTM D2310 - Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe; 2006 (Reapproved 2012).
B. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
D. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2011.
E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
G. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2013.
H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
I. ASSE 1060 - Performance Requirements for Outdoor Enclosures for Fluid Conveying Components; 2017 (Reaffirmed 2021).
J. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
L. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
M. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
N. ASTM A674 - Standard Practice for Polyethylene Encasement for Ductile Iron Pipe; 2022.
O. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
P. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).
Q. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
R. ASTM B63 - Standard Test Method for Resistivity of Metallically Conducting Resistance and

Contact Materials; 2007 (Reapproved 2018).
S. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
T. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
U. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications; 2022.
V. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
W. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.
X. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
Y. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2023.
Z. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
AA. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter; 2022.
BB. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 2019.
CC. ASTM D3839 - Standard Guide for Underground Installation of "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe; 2014 (Reapproved 2019).
DD. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).
EE. ASTM F2620 - Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings; 2020a, with Editorial Revision (2022).
FF. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
GG. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings; 2022.
HH. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.
II. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
JJ. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
KK. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.
LL. AWWA C203 - Coal-Tar Protective Coatings and Linings for Steel Water Pipe; 2020.
MM. AWWA C205 - Cement–Mortar Protective Lining and Coating for Steel Water Pipe—4 In. (100 mm) and Larger—Shop Applied; 2018.
NN. AWWA C206 - Field Welding of Steel Water Pipe; 2023.
OO. AWWA C209 - Tape Coatings for Steel Water Pipe and Fittings; 2019.
PP. AWWA C502 - Dry-Barrel Fire Hydrants; 2018.
QQ. AWWA C503 - Wet-Barrel Fire Hydrants; 2021.
RR. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2023.
SS. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2017.
TT. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances; 2023.
UU. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings; 2021.
VV. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2020.
WW. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2019.
XX. AWWA C702 - Cold-Water Meters -- Compound Type; 2019.
YY. AWWA C703 - Cold-Water Meters -- Fire-Service Type; 2019.
ZZ. AWWA C707 - Encoder-Type Remote-Registration Systems for Cold-Water Meters; 2022.
AAA. AWWA C800 - Underground Service Line Valves and Fittings; 2021.
BBB. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm); 2022.
CCC. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 3/4 In. (19 mm) Through 3 In. (76 mm), for Water Service; 2020.
DDD. AWWA M11 - Steel Pipe - A Guide for Design and Installation; 2017, with Addendum (2019).
EEE. AWWA M23 - PVC Pipe—Design and Installation; 2020. FFF. CDA A4015 - The Copper Tube Handbook; Current Edition. GGG. FM (AG) - FM Approval Guide; current edition.
HHH. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.

III. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata. JJJ. NSF 372 - Drinking Water System Components - Lead Content; 2022.
KKK. UL (DIR) - Online Certifications Directory; Current Edition.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of piping with size, location and installation of service utilities.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Welders Certificate: Include welders' certification of compliance with ASME BPVC-IX.
C. Product Data:
    1. Include data on pipe materials, pipe fittings, valves, and accessories.
    2. Provide manufacturer's catalog information.
    3. Indicate valve data and ratings.
    4. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
E. Samples: Submit two paper chip samples, illustrating range of colors and textures available for each surface finishing product scheduled.
F. Test Reports: Factory certified tests to verify that short-term rupture strength for RTRP I (filament bound) jointing is 1,500 psi (10.3 MPa) or greater.
G. Field Quality Control Submittals: Testing activities.
H. Project Record Documents:
    1. Record actual locations of piping mains, valves, connections, fire hydrants, free-standing fire department connections, underground manholes and vaults, valve boxes, thrust restraints, and invert elevations.
    2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
I. Maintenance Data: Include installation instructions, spare parts lists, and exploded assembly views.
J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements for additional provisions.
    2. Valve Repacking Kits: One for each type and size of valve.

1.07 QUALITY ASSURANCE

A. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.
C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years' documented experience.
D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
E. Provide grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.
F. Date stamp castings used for coupling housings, fittings, and valve bodies for quality assurance and traceability.
G. Coupling Manufacturer:
    1. Perform on-site training by factory-trained representative to Contractor's field personnel in the proper use of grooving tools and installation of grooved joint products.
    2. Periodic job site visits by factory-trained representatives to ensure best practices in grooved joint installation.
    3. A distributor's representative is not considered qualified to perform the training.
H. Welder Qualifications:
    1. Certify in accordance with ASME BPVC-IX.

2. Provide certificate of compliance from local Authority Having Jurisdiction, indicating approval of welders.

I. Valves: Bearing product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.

J. Products:
   1. Listed, classified, and labeled as suitable for the purpose specified and indicated.
   2. Refer to FM (AG) - FM Approval Guide and UL (DIR).

K. Perform Work in accordance with local authorities having jurisdiction, municipality, and water utility requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.09 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

1.10 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five-year period after Date of Substantial Completion.

C. Provide ten-year manufacturer warranty for dry-barrel fire hydrants on manufacturer's defects and labor costs for replacement.

PART 2 PRODUCTS

2.01 WATER PIPE

A. Steel Pipe and Fittings:
   1. Pipe: Standard weight, zinc-coated, listed, ASTM A53/A53M.
   2. Fittings: Comply with ASME B16.3 Class 150, zinc coated, threaded or ASME B16.4 Class 125, zinc-coated
   3. Mechanically Factory Applied Protective Materials:
      a. Clean by wire brushing and solvent cleaning.
      b. Apply one coat of coal-tar primer and two coats of coal-tar enamel complying with AWWA C203.
      c. Protect threaded pipe ends and fittings prior to coating.

B. Ductile Iron Pipe: Listed, AWWA C104/A21.4:
   1. Manufacturers:
      a. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Fittings: Ductile iron, standard thickness.
   3. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR gasket with rods.
   4. Jackets: AWWA C105/A21.5 polyethylene jacket.

C. Ductile Iron Pipe: Listed, AWWA C151/A21.51.
   1. Manufacturers:
      a. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Fittings: AWWA C110/A21.10, ductile iron, standard thickness.
   3. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR rubber gasket with 3/4 inch (19 mm) diameter rods.

2.02 VALVES

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Double Check Detector Valve Assembly, Flanged End:
   1. Manufacturers:
      a. Ames Fire and Waterworks: www.amesfirewater.com.
      b. FEBCO: www.febcoonline.com.
      c. Watts Water Technologies: www.watts.com.
   2. 2-1/2-inch NPS (65 mm, DN) to 10-inch NPS (250 mm, DN):
      a. Construction:

1) Body: 300 Series stainless steel or ASTM A536 Grade 65-45-12 ductile iron.
2) Two independently operating, spring-loaded, check valves.
3) Two OSY resilient seated gate valves.
4) Bypass Assembly:
   (a) Bypass Line: Hydraulically sized to accurately measure low flow.
   (b) Double check including shut-off valves and required cocks.
5) Cam-Check:
   (a) Internally loaded, providing positive, drip-tight closure against reverse flow.
   (b) Stainless steel cam arm and spring, rubber-faced disc, and replaceable, thermoplastic seat.
6) Valve Cover:
   (a) Provides access to all internal parts.
   (b) Held in place through the use of a single grooved style two-bolt coupling.

2.03 FIRE DEPARTMENT CONNECTIONS:

A. Free-Standing Inlet:
   1. Manufacturers:
      a. Elkhart Brass Manufacturing Company, Inc: www.elkhartbrass.com.
      b. Fire End & Croker Corporation: www.croker.com.
      c. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Construction:
      a. Type: Free standing type ASTM B584 poured brass alloy.
      b. Inlets: Two-way, 2-1/2-inch NPS (65 mm, DN) female inlets, thread size compatible with fire department hardware.
      c. Rated Working Pressure: 175 psi (1200 kPa).
      d. Double clapper-valves, rocker-lug caps and chain, and cast-in function-identifying lettering.
      e. Finish: Polished brass.
      f. Label: Sprinkler - Fire Department Connection.

2.04 PRIVATE FIRE HYDRANTS

A. Dry-Barrel:
   1. Manufacturers:
      a. American AVK Company: www.americanavk.com.
      b. Kennedy Valve Company: www.kennedyvalve.com.
      c. Mueller Company: www.muellercompany.com.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Construction:
      a. Listed, AWWA C502.
      b. Rated Working Pressure: 250 psi (1725 kPa).
      c. Compression type, opening against system pressure and closing with system pressure.
      d. Traffic breakaway type.
   3. Hydrant Cap and Stuffing Box: One piece design with water-tight cavity, sealed from contact with water.
   4. Operating Nut: One-Piece, bronze construction with protective weather seal or shield.
   5. Nozzles: Tamper resistant, 1/4 turn type with O-ring seals including retaining/locking screws or other suitable nozzle lock to prevent inadvertent removal.
   6. Main Valve: Provide reinforced, synthetic rubber or completely encapsulated with EPDM.
   7. Seat: Provide O-rings to seal drain-way and barrel from water leakage into shoe.
   8. Drains to momentarily flush outward when opened to remove debris and complete draining upon closing of the main valve.

2.05 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type specified in *Division 03 30 00*.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

3.02 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
B. Remove scale and dirt on inside and outside before assembly.
C. Prepare pipe connections to equipment with flanges or unions.

3.03 TRENCHING

A. Hand trim excavation for accurate placement of pipe to elevations indicated.
B. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories
C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.04 INSTALLATION

A. General Requirements:
    1. Location of Water Lines:
        a. Terminate the work covered by this Section at a point approximately 5 feet (1.5 m) from the building unless indicated otherwise.
        b. Do not install water line closer horizontally than 10 feet (3 m) from any sewer line unless indicated otherwise.
        c. Water Piping Parallel With Sewer Piping:
            1) Install water piping minimum 10 feet (3 m) horizontally (measured edge-to-edge) from a sewer or sewer manhole where possible.
            2) Bottom (Invert) of Water Piping:
                (a) Minimum 18 inches (450 mm) above top (crown) of sewer piping.
                (b) Where this vertical separation of 18 inches (450 mm) above top (crown) of sewer piping cannot be obtained, the installation will be acceptable only when sewer piping is constructed of AWWA approved water pipe and pressure tested in place without leakage prior to backfilling.
            3) Sewer manhole must be of watertight construction and tested in place.
        d. Water Piping Crossing Sewer Piping:
            1) Crossing Under:
                (a) Where water lines cross under gravity sewer lines, encase sewer line fully in concrete for a distance of at least 10 feet (3 m) on each side of the crossing, unless sewer line is made of pressure pipe with rubber gasketed joints and no joint is located within 3 feet (900 mm) horizontally of the crossing.
            2) Crossing Over:
                (a) Install water lines which cross over sewer force mains and inverted siphons at least 2 feet (600 mm) above these sewer lines; when joints in the sewer line are within 3 feet (900 mm) horizontally from the water line, encase joints in concrete.
                (b) Provide a separation of at least 18 inches (450 mm) between the bottom of the water piping and the top of the sewer piping.
                (c) When local conditions prevent a minimum, vertical separation as described above, use the following construction:
                    (1) Provide sewer piping passing over or underwater piping constructed of AWWA approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.
                    Protect water piping passing under sewer piping by providing a vertical separation of at least 18 inches (450 mm) between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet (6.1 m), of the water piping be centered at the point of the crossing so that joints are equidistant and located as far as possible from the sewer piping.
        e. Do not install water lines in the same trench with gas lines, fuel lines, or electric wiring.
        f. Do not install copper tubing in the same trench with ferrous piping materials.
        g. Do not install water piping through or to come into contact with any part of a sewer

manhole.
h. Where nonferrous metallic pipe crosses any ferrous piping, provide a minimum vertical separation of 1 foot (300 mm) between pipes.

2. Sleeving:
   a. Sleeve water piping where piping is required to be installed within 3 feet (900 mm) of existing structures.
   b. Provide ductile iron or Schedule 40 steel, or sleeves.
   c. Fill annular space between pipe and sleeves with mastic.
   d. Install water pipe and sleeve without damaging structures or causing settlement or movement of foundations or footings.
3. Pipe Laying and Jointing:
   a. Remove fins and burrs from pipe and fittings.
   b. Prior to placing in position, clean pipe, fittings, valves, and accessories, and maintain in clean condition.
   c. Provide proper facilities for lowering pipe sections into trenches.
   d. Dropping or dumping of piping, fittings, valves, or any other water line material into trenches is not permitted.
   e. Cut pipe in a neat, workmanlike manner accurately to length established at the site and work into place without forcing or springing.
   f. Replace by one of the proper lengths any pipe or fitting that does not allow sufficient space for proper installation of jointing material.
   g. Wedging or blocking between bells and spigots will not be permitted.
   h. Install bell-and-spigot pipe with the bell end pointing in the direction of laying.
   i. Grade the pipeline in straight lines avoiding the formation of dips and low points.
   j. Support piping at proper elevation and grade.
   k. Secure firm, uniform support.
   l. Wood support blocking will not be permitted.
   m. Install pipe so that the full length of each pipe section and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings.
   n. Provide anchors and supports where indicated, necessary, and for fastening work into place.
   o. Provide proper provisions for expansion and contraction of pipelines.
   p. Keep trenches free of water until joints have been properly made.
   q. Close open ends of piping temporarily with wood blocks or bulkheads at the end of each workday.
   r. Do not install pipe during unacceptable trench conditions or inclement weather.
   s. Minimum Depth of Pipe Cover: Not less than 2-1/2 feet (760 mm).
4. Tracer Wire:
   a. Install continuous length of tracer wire for the full length of each run of nonmetallic pipe.
   b. Attach wire to top of pipe securely to prevent displacement during installation.
5. Connections to Existing Water Lines:
   a. Make connections to existing water lines only after receiving approval from the Architect.
   b. Ensure minimal interruption of service on the existing line.
   c. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped.
6. Penetrations:
   a. Provide ductile-iron or Schedule 40 steel for pipes passing through walls of valve pits and structures.
   b. Fill annular space between sleeves and walls with rich cement mortar.
   c. Fill annular space between pipe and sleeves with mastic.
7. Flanged Pipe: Install only above grade.

B. Special Requirements:
1. Ductile Iron Piping:
   a. Unless otherwise specified, install pipe and fittings in accordance with paragraph

"General Requirements".

b. Jointing:
   1) Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly.
   2) Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11.
   3) Make flanged joints with the gaskets, bolts, and nuts specified for this type joint.
      (a) Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other accessories and equipment.
      (b) Align bolt holes for each flanged joint.
      (c) Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted.
      (d) Do not allow adjoining flange faces to be out of parallel to such a degree that the flanged joint cannot be made watertight without over-straining the flange.
      (e) When flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions.
      (f) Use set-screwed flanges to make flanged joints where conditions prevent the use of full length, flanged pipe and assemble in accordance with the recommendations of the set-screwed flange manufacturer.
   4) Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer.
   5) Make grooved and shouldered type joints with the couplings previously specified for this type joint connecting pipe with the grooved or shouldered ends specified for this type joint; assemble in accordance with the recommendations of the coupling manufacturer.
      (a) Groove pipe in the field only with approved grooved cutting equipment designed especially for the purpose and produced by a manufacturer of grooved joint couplings; secure approval for field-cut grooves before assembling the joint.
   6) Make insulating joints with the gaskets, sleeves, washers, bolts, and nuts previously specified for this type joint.
      (a) Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves be full size for the bolt holes.
      (b) Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.

c. Allowable Deflection:
   1) Maximum Allowable Deflection: As stated in AWWA C600.
   2) If the alignment requires deflection in excess of the above limitations, furnish special blends or a sufficient number of shorter pipe lengths to provide angular deflections within the limit set forth.

d. Pipe Anchorage:
   1) Provide concrete thrust blocks (reaction backing), for pipe anchorage except where metal harness is indicated.
   2) Thrust blocks to comply with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks to be as indicated.
   3) Use concrete, ASTM C94/C94M, having a minimum compressive strength of 2,500 psi (15 MPa) at 28 days; or use concrete of a mix not leaner than one part cement, 2-1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.
   4) Provide metal harness in accordance with the requirements of AWWA C600 for thrust restraint, using tie rods and clamps as indicated in NFPA 13, except as otherwise indicated.

e. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using Class A polyethylene film, in accordance with AWWA C105/A21.5.

2. Steel Piping:
   a. Jointing:
      1) Bell-and-Spigot: Make rubber-gasketed, bell-and-spigot joints with the gaskets previously specified for this type of joint, using an approved lubricant, all in accordance with the pipe manufacturer's recommendations.
      2) Welded: Make welded joints in accordance with AWWA C206 and install in accordance with AWWA M11.
      3) Sleeve-Type Mechanical Coupling: Assemble sleeve-type mechanical coupling joints in accordance with the coupling manufacturer's recommendations.
      4) Flanged:
         (a) Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories.
         (b) Align bolt holes for each flanged joint.
         (c) Use full-size bolts for the bolt holes; use of undersized bolts due to misalignment of bolt holes or for any other purpose will not be allowed.
         (d) Do not allow adjoining flange faces to be out of parallel to such a degree that the flanged joint cannot be made water-tight without straining the flange.
         (e) When flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified, replace it with one of correct dimensions.
      5) Grooved:
         (a) Make grooved type joints with the couplings specified for this type joint connecting pipe with roll-grooved ends or pipe with welded-on cut-grooved adapters, each with dimensions as previously specified for this type of joint.
         (b) Groove pipe ends in the field only with approved groove rolling equipment and groove adapters in the field only with approved groove cutting equipment; use only groove rolling and groove cutting equipment designed especially for the purpose and produced by a manufacturer of grooved joint couplings.
         (c) Obtain approval for field-cut grooves prior to assembling the joint.
      6) Shouldered: Make shouldered type joints with the couplings specified for this type joint connecting pipe with the shouldered ends specified for this type of joint.
      7) Assemble joints in accordance with the recommendations of the coupling manufacturer.
      8) Insulating:
         (a) Make insulating joints with the gaskets, sleeves, washers, bolts, and nuts specified for this type joint.
         (b) Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves be full size for the bolt holes.
         (c) Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.
      9) Joint Finishing:
         (a) Finish joints on piping with cement-mortar lining and on piping with cement-mortar coating as specified in Appendix on Field Joints in AWWA C205.
         (b) Finish joints on piping with coal-tar-enamel or coal-tar epoxy coating by cleaning, priming, coating, and wrapping with a cold-applied tape coating complying with and applied in accordance with AWWA C209.
   b. Allowable Offsets:
      1) For pipe with bell-and-spigot rubber-gasket joints, 5 degrees maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets; unless a lesser amount is recommended by the manufacturer.
      2) Form short-radius curves and closures by short lengths of pipe or fabricated specials specified.
   c. Pipe Anchorage:
      1) Provide concrete thrust blocks (reaction backing) for pipe anchorage, except

where metal harness is indicated.

2) Thrust blocks to be in accordance with the recommendations for thrust restraint in AWWA M11, except that size and positioning of thrust blocks are to be as indicated.
3) Use ASTM C94/C94M concrete having a minimum compressive strength of 2500 psi (15 MPa) at 28 days; or use concrete of a mix not leaner than one part cement, 2-1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.
4) Metal Harness:
   (a) Provide in accordance with the recommendations for joint harnesses in AWWA M11, except as otherwise indicated.
   (b) Fabricated by the pipe manufacturer and furnished with the pipe.

3. Copper Piping:
   a. Install in accordance with the Copper Development Association's Copper Tube Handbook and manufacturer's recommendations - CDA A4015.
   b. Bed piping in 6 inches (150 mm) of sand.

C. Valves:
1. Set valves on solid bearing.
2. Center and plumb valve box over valve.
3. Set box cover flush with finished grade.

3.05 SERVICE CONNECTIONS

A. Provide fire water service to Local Authority Having Jurisdiction requirements with reduced pressure backflow preventer and water meter with by-pass valves and sand strainer.
B. Provide sleeve in retaining wall for service main. Support with reinforced concrete bridge. Caulk enlarged sleeve watertight.
C. Anchor fire service main to interior surface of foundation wall.
D. Provide 18-gauge, 0.0478-inch (1.21 mm) galvanized sheet metal sleeve surrounding service main to 6 inches (150 mm) above floor and 6 feet (1.83 m) minimum below grade. Size for 2 inches (50 mm) minimum of glass fiber insulation stuffing.

3.06 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
1. See *Division 01 40 00* - Quality Requirements, for additional requirements.
2. Provide all labor, equipment, and incidentals required for field testing, except that water and electric power needed for field tests will be furnished as set forth in *Division 01 50 00* - Temporary Facilities and Controls.
3. Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently and at least 5 days after placing of concrete after concrete thrust blocks have hardened sufficiently and at least 5 days after placing of concrete.
4. Prior to hydrostatic testing, obtain approval from Architect for proposed method for disposal of wastewater from hydrostatic testing.
5. The Architect will conduct field inspections and witness field tests as specified in this Section.
6. Fill pipeline 24 hours before testing and apply test pressure to stabilize system, using only potable water.
7. Before final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions and properly joined and sloped.
8. Test water piping in accordance with NFPA 13, where the additional water added to the system must not exceed the limits given in NFPA 13.
9. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
10. Prepare reports of testing activities.

3.07 CLEANING

A. Upon completion of the installation of water lines and appurtenances, remove and haul away all surplus material, including debris resulting from the work.

3.08 CLOSEOUT ACTIVITIES

A. See *Division 01 78 00* - Closeout Submittals, for closeout submittals.
B. See *Division 01 79 00* - Demonstration and Training, for additional requirements.
C. Demonstrate proper operation of equipment to Owner's designated representative.
D. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Conduct walking tour of project.
   3. Briefly describe function, operation, and maintenance of each component.
E. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Manufacturer's training personnel.
   4. Location: At project site.

DIVISION 21 13 00 - FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wet-pipe sprinkler system.
B. Dry-pipe sprinkler system.
C. System design, installation, and certification.
D. Fire department connections.

1.02 RELATED DOCUMENTS

A. Drawings and the General Conditions, Instructions to Bidders, and all other general requirements of these specifications shall be considered a component of this division of the specifications.
B. *Division 23* Section “General Provisions - Mechanical” shall also apply to this Section.
C. This Contractor shall examine all other divisions of the specifications and all drawings for the project and shall familiarize himself with all features of the project that may affect his work.
D. See other Sections for basic pipe and pipe fitting requirements, valves, pipe specialties, hangers, insulation, seismic restraint, etc.

1.03 SUMMARY

A. The work shall include the necessary design, hydraulic calculations, shop drawings, labor, materials, appliances, and equipment to install the complete fire protection system in accordance with the requirements of the authorities having jurisdiction and these specifications with NO ADDITIONAL COST TO THE Owner unless the scope of the building changes. The work shown on the drawings represents the minimum requirements only.

1.04 RELATED REQUIREMENTS

A. *Division 21 05 48* - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.
B. *Division 21 05 53* - Identification for Fire Suppression Piping and Equipment.
C. *Division 21 30 00* - Fire Pumps.

1.05 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide; current edition.
B. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2012.
C. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.
D. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2013.
E. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2013.
F. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
G. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2016.
H. NFPA 1963 - Standard for Fire Hose Connections; 2019.
I. UL (DIR) - Online Certifications Directory; Current Edition.
J. UL 405 - Fire Department Connection Devices; Current Edition; Including All Revisions.
K. NFPA 20 – Standard for the Installation of Stationary Fire Pumps for Fire Protection.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.07 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Samples: Submit two of each style of sprinkler specified.

D. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

E. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.

F. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements for additional provisions.
   2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
   3. Sprinkler Wrenches: For each sprinkler type.

H. Shop Drawings: Before commencing the fabrication and installation of the fire protection system, submit appropriate shop drawings, design information, and equipment cut sheets to the governing authorities. The submittal shall include the following as a minimum:
   1. Scaled floor plan drawings on sheets of uniform size, no smaller than 1/8”=1’0” to include the following information.
      a. Name of owner.
      b. Location, including street address.
      c. Point of compass.
      d. Floor plan of each floor (if identical floors, typical plan permitted).
      e. Description of occupancy of each building.
         1) If storage facility, description and/or quantity of materials stored.
         2) If manufacturing facility, description of any unusual or hazardous processes.
      f. Building height in feet.
      g. Full height building cross section if required to clarify installation of system.
      h. Fire wall locations, large, unprotected floor openings, unprotected window openings, fire doors.
      i. Distances regarding code requirements of adjacent or nearby exposed buildings or structures.
      j. Type, temperature ratings, and locations of all sprinkler heads.
      k. Size and location of risers and standpipes with description and arrangement of valving and accessories, including the location of any and all hose valves, alarms, and signal devices.
      l. Size and location of all mains and location of all branch lines.
         1) Area protected by each riser, each system, each floor.
      m. If the project is in a seismic area and/or if seismic restraints and design are required by code, information attesting to this and restraint details shall be included on the drawings.
      n. The location and size of the remote area coverage.
      o. Pipe sizes for risers, feed mains, cross mains, standpipes, control valves.
      p. Size and type of meter and valve pits.
      q. Depth of top of buried pipe to grade.
      r. The fire pump design, specifications and room layout (if required).
      s. Standpipe design (if required) must be completely delineated on the shop drawings.
      t. If extensions are made to existing systems, the same information shall be provided for the existing as well as that for the extensions, including point of connection to the existing main.

u. The shop drawings shall fully identify the intent of the type of systems, such as dry, wet, pre-action, and/or deluge.

2. Site plans: The plan shall be drawn to scale and shall include all essential details such as (See Civil Engineering Drawings):
   a. Size and location of all water supplies.
   b. Size and location of all piping, indicating, where possible, the class and type of new pipe to be installed, and the depth to which it is to be buried.
   c. Size, type, and location of valves. Indicate if located in pit or if operation is by post indicator or key wrench through a curb box. Indicate the size, type, and location of meters, regulators, and check valves.
   d. Size and location of hydrants, showing size and number of outlets, and if outlets are to be equipped with independent gate valves. Indicate if hose houses and equipment are to be provided and by whom.
   e. Sprinkler and standpipe risers and monitor nozzles to be supplied with the system.
   f. Location of fire department connections; if part of private fire service main system, including details of connections.
   g. Water supply information:
      1) Information regarding whether the main is circulating or dead end.
      2) Pressures under flowing and static conditions. If available, information on orifice size and co-efficient of orifice used in the test, as well as pitot pressure.
      3) Applicable elevations of slab, floors, ceilings, street main connections, etc.
      4) Information regarding who conducted flow test, when, and where the test was conducted. If reliable or current (less than six months old) information is not available, a new flow test shall be done under the supervision of the Contractor.

3. Hydraulic calculations:
   a. The Contractor shall prepare and submit hydraulic calculations; documents shall include the information required by NFPA 13.

I. Submit the shop drawings and equipment cuts to the Architect for review. This submittal shall bear the governing authorities approval stamp.

J. At the completion of the work, the Contractor shall supply the Architect with 3 sets of approved drawings and equipment cuts. At least 1 set shall bear the approval stamp of the governing authority. These sets shall be "RECORD SET" and shall reflect changes made during construction.

1.08 QUALITY ASSURANCE

A. Maintain one copy of referenced design and installation standards on site.

B. Comply with FM (AG) requirements.

C. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

E. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years' experience and approved by manufacturer.

F. Equipment and Components: Provide products that bear FM (AG) label or marking.

G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.09 MOCK-UP

A. Provide components for installation in mock-up.

B. Mock-up may not remain as part of the Work.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Store products in shipping containers and maintain them in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.11 GOVERNING AGENCIES, CODES, PERMITS AND INSPECTION

A. The governing authority shall include Owner's Insurance Company.

B. Work shall comply with the national fire codes as published by the National Fire Protection Association and the governing authorities.

C. The Contractor shall obtain necessary permits required, paying fees, therefore.
D. The Contractor shall give required notice to the proper authorities relating to work under his charge and shall afford the Architect and authorized inspectors every facility for inspection.
E. Upon completion of the work, contractor shall obtain certificates of inspection and approval from the governing authority and deliver 3 copies to the Architect.

1.12 QUALIFICATIONS OF CONTRACTOR

A. Fire Protection Systems shall be installed by a Contractor with a specialty in automatic sprinkler and fire protection systems as required by authorities having jurisdiction. The Contractor must be licensed in the state where the project is located.
B. Specialty contracting license shall have to be in force for no less than 5 years.

1.13 GUARANTEE AND SERVICE

A. The entire fire protection installation, as specified and/or installed under this section of the specification, shall be guaranteed for 1 year against defective equipment, materials, and workmanship. The guarantee period is to begin on the date the building is accepted by the Owner, as attested by final payment or substantial completion, whichever is earlier.
B. During the 1-year guarantee period, the Contractor shall perform service as required.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sprinklers, Valves, and Equipment:
   1. Tyco Fire Protection Products, a Tyco Business: www.tyco-fire.com.
   2. Viking Corporation: www.vikinggroupinc.com.
   3. Reliable Automatic Sprinkler Co: www.reliablesprinkler.com.
   4. Victaulic: www.victaulic.com.
   5. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 SPRINKLER SYSTEM

A. Sprinkler System: Provide coverage for entire building.
B. Occupancy: Light hazard; comply with NFPA 13.
C. Water Supply: Determine volume and pressure from water flow test data.
   1. Revise design when test data are available prior to submittals.
D. Interface system with building fire and smoke alarm system.
E. Provide fire department connections where indicated.
F. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.
G. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
   5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
   6. Other Types: As required.
   7. Manufacturers:
      a. Powers Fasteners, Inc: www.powers.com.
      b. Red Head Anchors: www.itwredhead.com.
      c. Wedge-All
      d. Substitutions: See *Division 01 60 00*- Product Requirements.

2.03 SPRINKLERS

A. Suspended Ceiling Type: Semi-recessed pendant type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish: Brass.
   4. Escutcheon Plate Finish: Antique Brass.
   5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
B. Exposed Area Type: Pendant type with guard.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish: Brass.
   4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

C. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish: Brass.
   4. Escutcheon Plate Finish: Brass.
   5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
D. Dry Sprinklers: Concealed pendant-type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish: Brass.
   4. Cover Plate Finish: Brass.
   5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
E. Storage Sprinklers: Pendant type with guard.
   1. Response Type: Standard.
   2. Coverage Type: Standard.
   3. Finish: Chrome plated.
   4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
F. Guards: Finish to match sprinkler finish.
G. Flexible Drop System: Stainless steel, multiple use, open gate type.
   1. Application: Use to properly locate sprinkler heads.
   2. Include all supports and bracing.
   3. Provide braided type tube as required for the application.
   4. Manufacturers:
      a. Victaulic: www.victaulic.com.
      b. Viking Corporation: www.vikinggroupinc.com.
      c. Flexhead Brand of Anvil International: www.anvilintl.com.
      d. Substitutions: See *Division 01 60 00*- Product Requirements.

2.04 PIPING SPECIALTIES

A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
   1. Activate electric alarm.
   2. Test and drain valve.
   3. Replaceable internal components without removing valve from installed position.
   4. Manufacturers:
      a. Victaulic: www.victaulic.com.
      b. Reliable Automatic Sprinkler Co: www.reliablesprinkler.com.
      c. Viking Corporation: www.vikinggroupinc.com.
      d. Substitutions: See *Division 01 60 00*- Product Requirements.
B. Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm, accelerator, and with the following additional capabilities and features:
   1. Activate electric alarm.
   2. Test and drain valve.
   3. Externally resettable.
   4. Replaceable internal components without removing valve from installed position.
   5. Manufacturers:
      a. Victaulic: www.victaulic.com.
      b. Reliable Automatic Sprinkler Co: www.reliablesprinkler.com..
      c. Viking Corporation: www.vikinggroupinc.com.
      d. Substitutions: See *Division 01 60 00*- Product Requirements.
C. Backflow Preventer: Reduced pressure principal valve assembly backflow preventer with drain and OS & Y gate valve on each end.
D. Test Connections:
   1. Inspector's Test Connection for Pre-action Systems:
      a. Provide test connections approximately 6 ft (2 m) above floor for each or portion of

each sprinkler system equipped with an alarm device, located at the most remote part of each system.
b. Route test connection to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
c. Supply discharge orifice with same size as corresponding sprinkler orifice.
d. Limit vertical height of exterior wall penetration to 2 ft (0.61 m) above finished grade.
2. Backflow Preventer Test Connection:
a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5 inch (65 mm) National Standard male hose threads with cap and chain.
b. Furnish one valve for each 250 gpm (16 L/s) of system demand or fraction thereof.
c. Provide permanent sign reading "Test Valve" in accordance with Section 21 0553.

E. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.
F. Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.
G. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125-volt AC and 2.5 amp at 24-volt DC.
H. Fire Department Connections:
1. Type: Free standing made of corrosion resistant metal complying with UL 405.
a. Inlets: Two way, 2-1/2-inch (65 DN) swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or Authority Having Jurisdiction. Brass caps with gaskets, chains, and lugs.
b. Configuration: Horizontal.
c. Outlet: Bottom with pipe threads, 4 NPS (100 DN).
1) Location: Back.
d. Rated Working Pressure: 175 psi (1200 kPa).
e. Finish: Chrome.
f. Sleeve: Brass, 18 inches (460 mm) height.
g. Signage: Raised or engraved lettering 1 inch (25.4 mm) minimum indicating system type.
I. Residential Domestic Shut-Off Valve: NFPA 13R, bronze and stainless steel construction, with sprinkler check valve assembly and poppet assembly to divert water from domestic system.
1. Product: TYCO.
a. Substitutions: See *Division 01 60 00* - Product Requirements.

2.05 PRESSURE MAINTENANCE PUMP

A. Manufacturers:
1. Grundfos Pumps Corporation: www.grundfos.com.
2. Goulds Pumps: www.gouldspumps.com.
3. Armstrong Pump: www.armstrong-pump.com.
4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Type: Close coupled motor and positive displacement pump unit.
C. Construction: Bronze with stainless steel shafts, carbon bearings.
D. Motor: Open drip-proof permanently lubricated.
E. Electrical Characteristics:
1. 0.33 hp.
2. 115 volts, single phase, 60 Hz.
F. Accessories: Include flexible hose connections.
G. Operation: Manual.

2.06 AIR COMPRESSOR

A. Manufacturers:
1. DeWalt: www.dewalt.com.
2. Porter Cable: www.portercable.com.
3. Ingersoll Rand: www.ingersollrand.com.
4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Compressor: Single-unit, electric motor driven, motor, motor starter, safety valves, check valves, air maintenance device incorporating electric pressure switch and unloader valve.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with referenced NFPA design and installation standard.
B. Install equipment in accordance with manufacturer's instructions.
C. Install buried shut-off valves in valve box. Provide post indicator.
D. Provide approved double check valve assembly at sprinkler system water source connection.
E. Locate outside alarm gong on building wall as indicated.
F. Place pipe runs to minimize obstruction to other work.
G. Place piping in concealed spaces above finished ceilings.
H. Center sprinklers in two directions in ceiling tiles and provide piping offsets as required.
I. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
J. Install and connect to fire pump system in accordance with *Division 21 30 00*.
K. Install air compressor on vibration isolators. Refer to *Division 21 05 48*.
L. Flush entire piping system of foreign matter.
M. Install guards on sprinklers where indicated.
N. Hydrostatically test entire system.
O. Require test be witnessed by Fire Marshal.

3.02 INTERFACE WITH OTHER PRODUCTS

A. Ensure required devices are installed and connected as required to fire alarm system.

DIVISION 21 30 00 – FIRE PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Inline fire pump.
B. Vertical turbine fire pump.
C. Electric motor drive.
D. Jockey pump.

1.02 RELATED DOCUMENTS

A. Drawings and General Conditions, Instructions to Bidders, and all other general requirements of these specifications shall be considered a component of this division of the specifications.
B. *Division 21* "Fire Protection - General" and *Division* 23 "General Provision - Mechanical" shall also apply to this section.
C. This Contractor shall examine all other divisions of the specifications and all drawings for the project and shall familiarize himself with all features of the project that may affect his work.
D. See other Sections for basic pipe and pipe fitting requirements, valves, pipe specialties, hangers, insulation, seismic restraint, etc.

1.03 RELATED REQUIREMENTS

A. *Division 21 05 00* - Common Work Results for Fire Suppression: Fire protection piping.
B. *Division 21 05 13* - Common Motor Requirements for Fire Suppression Equipment.
C. *Division 21 05 48* - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.
D. *Division 22 07 16* - Plumbing Equipment Insulation.
E. *Division 26 05 83* - Wiring Connections: Electrical characteristics and wiring connections.
F. *Division 28 46 00* - Fire Detection and Alarm.

1.04 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide; current edition.
B. NEMA MG 1 - Motors and Generators; 2014.
C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
D. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
E. NFPA 20 - Standard for the Installation of Stationary Pumps for Fire Protection; 2022.
F. UL (DIR) - Online Certifications Directory; Current Edition.
G. UL 448 - Centrifugal Stationary Pumps for Fire-Protection Service; Current Edition, Including All Revisions.
H. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.
I. UL 1478 - Fire Pump Relief Valves; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.06 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturers literature including general assembly, pump curves showing performance characteristics with pump and system, operating point indicated, NPSH curve, controls, wiring diagrams, and service connections.
C. Shop Drawings: Indicate layout, general assembly, components, dimensions, weights, clearances, and methods of assembly.
D. Certificates: Certify that fire pumps meet or exceed specified requirements at specified operating conditions and that the installation complies with regulatory requirements. Submit summary and results of shop tests performed in accordance with NFPA 20
E. Test Reports: Indicate results of hydrostatic test and field acceptance tests.
F. Manufacturer's Instructions: Indicate support details, connection requirements, for fire pump system.
G. Maintenance Contract.
H. Operation Data: Include manufacturer's instructions, start-up data, trouble-shooting check lists, for pumps, drivers, and controllers.
I. Maintenance Data: Include manufacturers literature, cleaning procedures, replacement parts lists, and repair data for pumps, drivers and controllers.
J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional provisions.
    2. Extra Pump Gaskets/Screens/Seals: One set for each different pump model.
K. Manufacturer Seismic Qualification Certification: Submit certification that fire pumps and drivers and fire-pump controllers, pressure-maintenance pumps, accessories, and specialties will withstand seismic forces defined in Section 21 0548 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment:
    1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
        a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
    2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
    3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.07 QUALITY ASSURANCE

A. Comply with NFPA 13 and NFPA 20; where requirements differ comply with the most stringent.
B. Maintain on site at all times one copy of each design and installation standard referenced.
C. Design fire pump system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the State in which the Project is located.
D. Equipment and Components: Bearing FM (AG) label or marking.
E. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
F. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
G. Installer Qualifications: Company specializing in performing the work of this section with minimum five years' experience.
H. Provide certificate of compliance from authority have jurisdiction indicating approval of field acceptance tests.
I. Comply with standards of Authorities Having Jurisdiction pertaining to materials, hose threads, and installation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire pumps and components in factory packing. Comply with manufacturer's rigging and installation instructions.
B. Protect fire pumps and components from physical damage including effects of weather, water,

and construction debris.

C. Provide temporary inlet and outlet caps and maintain in place until installation.

PART 2 PRODUCTS

2.01 FIRE PUMPS

A. Inline Fire Pump:
   1. Manufacturers:
      a. AC Fire Pump, a Xylem brand: www.acfirepump.com/#sle.
      b. Aurora, a Pentair brand: www.pentair.com/#sle.
      c. Fairbanks Nijhuis, a Pentair brand: www.pentair.com/#sle.
      d. SPP Pumps, Inc: www.spppumps.com/#sle.
      e. SyncroFlo, Inc: www.syncroflo.com/#sle.
      f. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. UL 448 and UL 778; vertical- or horizontal-mounted, single-stage, close-coupled centrifugal pump for maximum working pressure of 186 psi (1,282 kPa).
   3. Casing: Cast or ductile iron, or bronze with suction and discharge gauge port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.
   4. Impeller: Bronze, fully enclosed, keyed directly to motor shaft.
   5. Shaft: Solid alloy steel with bronze sleeves.
   6. Seal: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 230 degrees F (110 degrees C) maximum continuous operating temperature.

B. Vertical Turbine Fire Pump:
   1. Manufacturers:
      a. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
      b. Aurora, a Pentair brand: www.pentair.com/#sle.
      c. Fairbanks Nijhuis, a Pentair brand: www.pentair.com/#sle.
      d. Peerless Pump Company: www.peerlesspump.com/#sle.
      e. SPP Pumps, Inc: www.spppumps.com/#sle.
      f. SyncroFlo, Inc: www.syncroflo.com/#sle.
      g. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. UL 448 and UL 778; vertical, multistage centrifugal pump for well water source for maximum working pressure of 510 psi (3,516 kPa).
   3. Casing: Cast iron rated for 1.20 times actual working pressure. Include discharge gauge, air vent, wear rings, seal flush connection, drain plug, and flanged discharge.
   4. Impellers: Bronze, fully enclosed, keyed to shaft or secured with lock nut.
   5. Shaft: Stainless steel or carbon steel with bronze or stainless steel sleeve through seal chamber.
   6. Seals: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings.

C. Accessories:
   1. Eccentric suction reducer and OS&Y gate or butterfly valve on suction side of pump.
   2. Concentric increaser and check valve in pump discharge and OS&Y gate or butterfly valve on system side of check valve.
   3. Fire pump bypass fitted with OS&Y gate or butterfly valves and check valves.
   4. Main relief valve, UL 1478 and enclosed type waste cone.
   5. Suction pressure gauge, 4-1/2-inch (110 mm) diameter dial with snubber, valve cock and lever handle.
   6. Discharge pressure gauge mounted on board attached to pump, with snubber, valve cock and lever handle.
   7. 3/4-inch (20 mm) casing relief valve.
   8. Float operated 3/4 inch (20 mm) automatic air release valve.
   9. Hose valve manifold with 2-1/2-inch (65 mm) hose gate valves with caps and chains.
   10. Flow metering system for closed loop testing.

2.02 ELECTRIC MOTOR DRIVE:

A. Motor: Squirrel cage induction type, NEMA MG 1; in open drip-proof NEMA 250 enclosure, 3,500 rpm; see *Division 21 05 13*.

B. Controller: Limited-service type with auto-transformer starter, in NEMA 250 enclosure, including

the following:

1. Disconnect Switch: Externally operable, quick break type.
2. Circuit Breaker: Comply with NFPA 20; minimum 65,000 amperes interrupting capacity.
3. Motor Starter: Energized automatically through pressure switch or manually by externally operable handle.
4. Pressure Switch: Set to cut in at 60 psi
5. Running Period Timer: Keeps motor in operation when started automatically, for a minimum of seven minutes.
6. Pilot Lamp: Indicates circuit breaker closed and power available.
7. Test Accessories: Ammeter test link and voltmeter test studs.
8. Alarm Relay: Energizes alarm to indicate circuit breaker open or power failure.
9. Switch Relay: For remote start.
10. Manual Selector Station: On enclosure marked "Automatic" and "Non-Automatic".

2.03 JOCKEY PUMP

A. Manufacturers:
   1. Armstrong Pumps Inc: www.armstrongpumps.com.
   2. Aurora, a Pentair brand: www.pentair.com/#sle.
   3. Fairbanks Nijhuis, a Pentair brand: www.pentair.com/#sle.
   4. Grundfos: www.us.grundfos.com.
   5. Talco Fire Systems: www.talcofire.com.
   6. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Electrically operated, horizontal or vertical, single or multistage, turbine type centrifugal pump with standard open drip-proof horizontal motor.

C. Control by automatic jockey pump controller with full voltage starter and minimum run timer to start pump on pressure drop in system and stay in operation for minimum period of time. Fire pumps shall start automatically on further pressure drop or on jockey pump failure.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with NFPA 20.

B. Provide access space around pumps for service; no less than minimum as recommended by manufacturers.

C. Piping: Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For base mounted pumps, provide supports under elbows on pump suction and discharge; see Section 21 0500.

D. Provide drains for bases and seals, piped to and discharging into floor drains.

E. Mount unit on vibration isolators; see *Division 21 05 48*.

F. Provide for connection to electrical service; see *Division 26 05 83*.

G. Lubricate pumps before start-up.

H. Check, align, and certify pumps by qualified installer prior to start-up.

I. Provide supervisory alarm notifications using auxiliary dry contacts interconnected into fire alarm system for monitoring by Owner-designated central or off-site point of constant attendance; see *Division 28 46 00*.

J. Install and align fire pump, pressure-maintenance pump, and controller according to NFPA 20.

K. Install pumps and controllers to provide access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

L. Install valves that are same size as piping connecting fire pumps, bypasses, test headers, and other piping systems.

M. Install pressure gages on fire-pump suction and discharge at pressure-gage tappings.

N. Support pumps and piping separately so weight of piping does not rest on pumps.

O. Install piping accessories, hangers and supports, anchors, valves, meters and gages, and equipment supports.

P. Install flowmeters and sensors where indicated. Install flowmeter-system components and make connections according to manufacturer's written instructions.

Q. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.

3.02 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements for additional requirements.
B. Perform hydrostatic tests, flushing, and field acceptance tests as specified in NFPA 20.
C. Perform field acceptance tests in the presence of Fire Marshal.

3.03 CLOSEOUT ACTIVITIES

A. See *Division 01 78 00* - Closeout Submittals for additional submittals.
B. See *Division 01 79 00* - Demonstration and Training for additional requirements.
C. Demonstrate automatic operation of system including verification of pressure switch set points to Owner.
D. Use operation and maintenance data as reference during demonstration.
E. Briefly describe function, operation, and maintenance of each component.
F. Conduct walking tour of project.
G. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Manufacturer's training personnel.
   4. Location: At project site.

3.04 MAINTENANCE

A. See *Division 01 70 00* - Execution and Closeout Requirements for additional requirements.
B. Provide a separate maintenance contract for specified maintenance service.
C. Perform maintenance using competent personnel in the direct employ of the system installer.
D. Provide service and maintenance of equipment installed under this section for one year from the Date of Substantial Completion.

DIVISION 22 05 00 - PLUMBING SYSTEM

PART 1 GENERAL

All water consuming devices shall be approved water saving type. Provide freeze protection on all water lines subject to freezing conditions.

Provide a ball valve in branch piping to all exterior hose bibs. Where suitable, locate hose bibs adjacent to exterior mechanical rooms, dropping branch piping exposed in mechanical room and locating ball valve a maximum of 6'-0" above floor finish.

Location of all shut-off valves for plumbing, HVAC, gas or other shut off shall be coordinated and located in proximity of one another to minimize access panels in hard ceilings and for ease of access everywhere.

Require Contractor to completely rod and flush out all sanitary waste lines, both new and existing, and coordinate with Owner-provided “smoke test” of all sanitary piping.
All sinks shall have both cold and hot water supply.

Provide metal chrome escutcheon rings at all exposed ceiling and wall penetrations.

Provide isolation valves in cold water and hot water piping so that water can be shut off to each classroom wing. Specify plaster type P-traps for all art room sinks.

1.01 RELATED DOCUMENTS

A. Drawings and the General Conditions, Instructions to Bidders, and all other general requirements of these specifications shall be considered a component of this division of the specifications.
B. This section of the specifications includes general provisions applicable to all work of *Division 22*.
C. This Contractor shall examine all other divisions of the specifications and all drawings for the project and shall familiarize himself with all features of the project that may affect his work.

1.02 CONTRACT DOCUMENTS

A. Refer to and comply with other sections of these specifications in the installation of all Plumbing Work.
B. Drawings are diagrammatic; therefore, all offsets, fittings, valves and accessories are not shown.

Plan work around building details and other crafts.

1.03 CODES, ORDINANCES, INSPECTIONS AND PERMITS

A. Work is to be executed and inspected in accordance with local and state codes, laws, ordinances, rules and regulations applicable to particular class of work, and any fees in connection therewith are to be paid by the Contractor.
B. Arrange with City, or State if City has no ordinances covering work, for complete inspection, paying all charges pertaining thereto.

1.04 SHOP DRAWINGS, SUBMITTALS AND SUBSTITUTIONS

A. Submit within 30 days after Notice to Proceed, manufacturer's catalog sheets and/or shop drawings covering all phases of work included in this contract.
B. Submittals shall be complete, arranged in sets and bound in folders. No loose sheets or partial submittals will be acceptable.
C. Submittals are required even though equipment being furnished is exactly as specified.
D. Final decision as to whether or not a specific piece of equipment meets specifications shall rest with Architect.
E. Should any proposed substitution require modifications to the electrical system (i.e., wire sizes, disconnects, fuses, etc.), such modifications shall be coordinated with the electrical Contractor and shall be made to the complete satisfaction of the Architect without additional cost to the Owner.

1.05 WARRANTY AND OPERATION INSTRUCTIONS

A. All materials and equipment shall carry a full year's warranty from time Owner accepts building or the date of substantial completion, whichever is earlier, regardless of start-up date of equipment, unless a longer warranty period is specified under other paragraphs of this section.
B. Turn over to Owner all operation instructions and warranties furnished with equipment.

1.06 EQUIPMENT CONNECTIONS

A. Each equipment item, with drain connections, shall be provided with a properly sized drain run to the nearest floor drain or as directed.
B. Rough-in and make final connection to all equipment furnished under Other Divisions of these Specifications or by the Owner.
C. Contractor shall install rough-ins only after he has received approved shop drawings or has obtained drawings and/or specifications for equipment provided by Owner and/or Owner's vendor.

1.07 FLASHINGS

A. Roof Flashings are to be furnished and installed under the Roofing Division of these Specifications.

1.08 CUTTING AND PATCHING

A. Provide all cutting and patching required to perform the Plumbing Work.
B. All patching shall be done by workmen skilled in the trade required.

1.09 EXCAVATION, TRENCHING AND BACKFILLING

A. All excavation, trenching and backfilling in connection with the Plumbing System is included as part of this Division.
B. All excavation required shall be done as part of the Bid Price regardless of any implied conditions on the Plans or in these Specifications.

1.10 SUPPORTS & FOUNDATIONS

A. The Contractor shall be responsible for the miscellaneous supporting systems.
B. Provide adequate pipe, equipment foundation and suspension systems in accordance with recognized engineering practices.
C. Pipe hangers shall be equal to those manufactured by B-Line.

1.11 ELECTRICAL

A. Furnish and install all electrical interlock and control wiring for proper operation and control of all Plumbing Equipment.
B. Supervise and coordinate all Electrical Work in connection with Plumbing System.
C. Furnish all motor controllers or contactors for proper operation of all motors.

1.12 TESTING AND ADJUSTING

A. Test all piping systems. Test buried pipe before backfilling.
B. Operate all Plumbing Equipment for a sufficient period of time to demonstrate that it is operating

properly.

C. Contractors will be required to make adjustment as necessary during the first year.

PART 2 - PLUMBING

2.01 FIXTURES AND TRIM

A. Fixtures shall be equal to those scheduled on the Drawings.

B. Provide all necessary support, trim and accessories required.

C. All exposed finished metal parts shall be chromium-plated.

D. All fixtures shall be provided with some form of supply stop.

2.02 PIPING

A. Water: Type “L” copper above grade; Type “K” copper below grade.

B. 2" and larger: All waste, vent, and sewer lines shall be of cast iron soil pipe and fittings and shall conform to the requirements of CISPI Standard 301, ASTM A 888, or ASTM A 74 for all pipe and fittings. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the Architect.

C. Schedule 40 PVC-DWV pipe and fittings may be used above slab when pipe is not located in ceiling return plenums. Assemble with solvent weld joints.

D. Schedule 40 PVC-DWV pipe and fittings may be used below slab. Schedule 40 PVC-DWV shall not be used where service temperatures are 140 degrees Fahrenheit and higher (Kitchens, Laundries, etc.). Assemble with solvent weld joints.

2.03 VALVES

A. Gate Valves: NIBCO T-111, S-111, or F-619.

B. Globe Valves: NIBCO T-211, S-211, or F-718-B.

C. Check Valves: NIBCO T-413, S-413, or F-918.

D. Ball Valves: NIBCO T-580 or S-580.

2.04 INSULATION

A. Domestic Cold Water (Above-Grade): Owens-Corning 1/2" thick fiberglass, one-piece, pipe insulation with factory-applied White All-Service (ASJ) Vapor Barrier Jacket. Fittings shall be molded or mitered fiberglass for pipe sizes under 3" and molded fiberglass for sizes 3" and larger.

B. Domestic Hot Water (Above-Grade): Owens-Corning 1" thick fiberglass, one-piece, pipe insulation with factory-applied White All-Service (ASJ) Vapor Barrier Jacket. Fittings shall be OC-110 cement for pipe sizes under 3" and molded fiberglass for sizes 3" and larger.

C. Domestic Hot Water (Below Grade): Insulate underground hot water piping with “Foamglas” and apply flexible PITTWRAP jacketing in accordance with manufacturer’s instructions.

D. Condensate drain piping shall be insulated same as domestic cold water.

DIVISION 22 05 13 - MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General construction and requirements.

B. Three phase electric motors.

1.02 RELATED REQUIREMENTS

A. *Division 26 05 83* - Wiring Connections: Electrical characteristics and wiring connections.

B. *Division 26 2913* - Enclosed Controllers.

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.

C. NEMA MG 1 - Motors and Generators; 2014.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
E. Operation Data: Include instructions for safe operating procedures.
F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for Plumbing and Hy use, and their accessories, with minimum five years' documented product development, testing, and manufacturing experience.
B. Comply with NFPA 70.
C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals for additional warranty requirements.
B. Provide five-year manufacturer warranty for motors larger than 20 horsepower.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Lincoln Motors: www.lincolnmotors.com.
B. A. O. Smith Electrical Products Company: www.aosmithmotors.com.
C. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service: Refer to *Division 26 05 83* for required electrical characteristics.
B. Electrical Service:
   1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
   2. Motors Larger than 3/4 Horsepower: 480 volts, three phase, 60 Hz.
C. Nominal Efficiency:
   1. Open Motor with Two Poles: 82.5.
   2. Open Motor with Four Poles: 82.5.
   3. Open Motor with Six poles: 50.0.
   4. Enclosed Motor with Two Poles: 75.5.
   5. Enclosed Motor with Four Poles: 82.5.
   6. Enclosed Motor with Six Poles: 50.0.
D. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 104 degrees F (40 degrees C) environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
   4. Motors with frame sizes 254T and larger: Energy efficient type.
E. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.
F. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
G. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Design, Construction, Testing, and Performance: Comply with NEMA MG 1 for Design B motors.

B. Insulation System: NEMA Class B or better.
C. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
D. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
E. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 2913.
F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
G. Sound Power Levels: To NEMA MG 1.
H. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
I. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
J. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.
K. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

DIVISION 22 05 19 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Positive displacement meters.
B. Flow meters.
C. Pressure gages and pressure gage taps.
D. Thermometers and thermometer wells.
E. Static pressure gages.
F. Strainers.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi; 2007.
C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014.
E. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2020.
F. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
G. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
   1. Submit brochures and other supportive data as might be required for approval of all items differing from those specified.
C. Samples: Submit two of each type of instrument specified.
D. Project Record Documents: Record actual locations of components and instrumentation.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See *Division 01 60 00* - Product Requirements. for additional provisions.
   2. Extra Pressure Gauges: One of each type and size.

1.05 QUALITY ASSURANCE

A. Ranges for thermometer, gages or similar instruments shall be selected so that normal operation will be near center of scale. Range shall not be longer than required. Use compound gage where vacuum may be encountered.

B. Combination instruments for thermometers and gages will not be acceptable.

1.06 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 WATER METERS

A. Compound Water Meters:
   1. Manufacturers:
      a. Badger Meter, Inc: www.badgermeter.com/#sle.
      b. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
      c. Mueller Systems, LLC: muellersystems.com/#sle.
      d. Sensus, a Xylem brand: www.sensus.com/#sle.
      e. Zenner USA: www.zennerusa.com/#sle.
      f. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Utility Connection Size: 3 inch (80 mm, DN) flanged.
   3. Maximum Unidirectional Water Flow Capacity: As indicated on drawings.
   4. Lead-free bronze alloy case, polymer-based cap, and hermetically sealed register.
   5. Pressure and Temperature: Up to 150 psi (10 bar) and 100 degrees F (38 degrees C).
   6. AWWA C702, with lead content below 0.25 percent when using non-lead-free materials on wetted surfaces according to NSF 61 and NSF 372.

B. Disc Water Meters:
   1. Manufacturers:
      a. Badger Meter, Inc: www.badgermeter.com/#sle.
      b. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
      c. Mueller Systems, LLC: muellersystems.com/#sle.
      d. Niagara Meters: www.niagarameters.com/#sle.
      e. Sensus, a Xylem brand: www.sensus.com/#sle.
      f. Zenner USA: www.zennerusa.com/#sle.
      g. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Utility Connection Size: 5/8-inch (16 mm, DN) NPT female.
   3. Maximum Unidirectional Water Flow Capacity: As indicated on drawings.
   4. Lead-free bronze alloy case and cap with hermetically-sealed mechanical register.
   5. Pressure and Temperature: Up to 150 psi (10 bar) and 100 degrees F (38 degrees C).
   6. AWWA C700, with lead content below 0.25 percent when using non-lead-free materials on wetted surfaces according to NSF 61 and NSF 372.

C. Detector-check Water Meters:
   1. Manufacturers:
      a. Badger Meter, Inc: www.badgermeter.com/#sle.
      b. Mueller Systems, LLC: muellersystems.com/#sle.
      c. Sensus, a Xylem brand: www.sensus.com/#sle.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Maximum Flow Rate Capacity: As indicated on drawings.
   3. Ductile iron case with polymer-based cap, integral test port, and hermetically sealed tamper-proof register with low flow indicator.
   4. Pressure and Temperature: Up to 175 psi (12 bar) and 150 degrees F (67 degrees C).
   5. FM (AG) listed, UL (DIR), and AWWA C703 Class II compliant meter with lead content below 0.25 percent when using non-lead-free materials on wetted surfaces according to NSF 61 and NSF 372.

D. Propeller Water Meters:
   1. Manufacturers:
      a. Badger Meter, Inc: www.badgermeter.com/#sle.
      b. McCrometer Inc: www.mccrometer.com.

c. Sensus, a Xylem brand: www.sensus.com/#sle.
d. Universal Flow Monitors, a DwyerOmega Brand: www.flowmeters.com.
e. Substitutions: See *Division 01 60 00* - Product Requirements.

2. Utility Connection Size: 24 inches (600 mm, DN) flanged with upstream strainer.
3. Maximum Unidirectional Water Flow Capacity: As indicated on drawings.
4. Cast bronze case, polymer-based cap, and hermetically sealed register.
5. Pressure and Temperature: Up to 150 psi (10 bar) and 100 degrees F (38 degrees C).
6. AWWA C704, with lead content below 0.25 percent when using non-lead-free materials on wetted surfaces according to NSF 61 and NSF 372.

E. Turbine Water Meters:

1. Manufacturers:
a. Badger Meter, Inc: www.badgermeter.com/#sle.
b. Mueller Systems, LLC: muellersystems.com/#sle.
c. Niagara Meters: www.niagarameters.com/#sle.
d. Onicon, Inc: www.onicon.com/#sle.
e. Sensus, a Xylem brand: www.sensus.com/#sle.
f. Zenner USA: www.zennerusa.com/#sle.
g. Substitutions: See *Division 01 60 00* - Product Requirements.
2. Inline Type: Class 150 flanged, sweat, or threaded, 1 inch (25 mm, DN).
3. Insertion Type: Include ball valve and threadolet.
4. Flow Capacity Range: As indicated on drawings.
5. Coated ductile iron case, polymer-based cap, test port, and hermetically sealed register with low flow indicator.
6. Pressure and Temperature: Up to 175 psi (12 bar) and 120 degrees F (49 degrees C).
7. AWWA C701 Class II, with lead content below 0.25 percent when using non-lead-free materials on wetted surfaces according to NSF 61 and NSF 372.

F. Ultrasonic Water Meters:

1. Manufacturers:
a. Onicon, Inc: www.onicon.com/#sle.
b. Rosemount, a brand of Emerson Electric Co: www.emerson.com/#sle.
c. Siemens USA: www.siemens.com/#sle.
d. Sierra Instruments, Inc: www.sierrainstruments.com/#sle.
e. Substitutions: See *Division 01 60 00* - Product Requirements.
2. Inline Type:
a. Copper, stainless steel, or aluminum pipe segment with wetted transducing sensors for 2-1/2-inch (65 mm, DN) pipe.
b. Accuracy: One percent of value applied to manufacturers specified velocity range.
c. Service Pressure and Temperature: Up to 400 psi (27.6 bar) and 32 to 250 degrees F (0 to 125.6 degrees C) liquid side, 130 degrees F (54.4 degrees C) ambient.
3. Clamp-on Type:
a. Non-wetted, stainless steel or aluminum clamps fitted with ultrasonic transducing sensors and circuitry fastened to 2-inch (50 mm, DN) pipe.
b. Accuracy: One percent of value applied to manufacturers specified velocity range.
c. Service Temperature: Minus 5 to 140 degrees F (Minus 20.5 to 60 degrees C) ambient.
4. Flow Capacity Range: As indicated on drawings.
Enclosure Construction: NEMA 250 Type 4 or 4X enclosure with backlit numeric display for consumption reading.
5. Output: Two-wire, 0 to 10 VDC, non-loop powered.

2.02 GAS METERS

A. Diaphragm Gas Meters:

1. Manufacturers:
a. Elster American Meter: www.elster-americanmeter.com/#sle.
b. Itron, Inc: www.itron.com/#sle.
c. Norgas, Inc: norgas.com/#sle.
d. Substitutions: See *Division 01 60 00* - Product Requirements.

2. Maximum Operating Line Pressure: 10 psi (0.7 bar).
3. Gas Flow Rate: Propane with flow rate as indicated on drawings.
4. Rangeability and Accuracy: 100 to 1 at plus or minus 1 percent.
5. Temperature Compensation: -30 to 140 degrees F (-34 to 60 degrees C).
6. B109.1/B109.2 of AGA/ANSI B109 Set, coated aluminum case with security seals, female threaded piping connection, and hermetically sealed register.

B. Rotary Gas Meters:
1. Manufacturers:
   a. Elster American Meter: www.elster-americanmeter.com/#sle.
   b. Norgas, Inc: norgas.com/#sle.
   c. Substitutions: See *Division 01 60 00* - Product Requirements.
2. Maximum Operating Line Pressure: Limit of 285 psi (19.6 bar).
3. Gas Flow Rate: Natural gas with flow rate as indicated on drawings.
4. Rangeability and Accuracy: 80 to 1 at plus or minus 2 percent.
5. Service Temperature Range: Minus 40 to 140 degrees F (Minus 40 to 60 degrees C).
6. B109.3 of AGA/ANSI B109 Set, coated aluminum case with security seals, flanged piping connection, low pressure drop, hermetically sealed register, pressure compensation, restrictive orifice plate, reverse flow, and temperature compensation.

C. Thermal-Mass Gas Meters:
1. Manufacturers:
   a. Fox Thermal Instruments, Inc: www.foxthermal.com/#sle.
   b. Onicon, Inc: www.onicon.com/#sle.
   c. Sierra Instruments, Inc: www.sierrainstruments.com/#sle.
   d. Substitutions: See *Division 01 60 00* - Product Requirements.
2. Inline Type: Class 150 flanged, 1-1/2 inch (40 mm, DN).
3. Insertion Type: Include ball valve and threadolet.
4. Flow Capacity Range: As indicated on drawings.
5. Construction: Stainless steel or aluminum sensor with integral NEMA 250 Type 4 or 4X stainless steel or aluminum enclosure with numeric display for consumption reading.
6. Accuracy: Two percent over measured flow range, adjustable.
7. Output: Two-wire, 0 to 10 VDC, non-loop powered.
8. Service Pressure and Temperature: Up to 300 psi (20.6 bar) and minus 40 to 250 degrees F (minus 40 to 125.6 degrees C) gas side, 150 degrees F (65.5 degrees C) ambient.

D. Turbine Gas Meters:
1. Manufacturers:
   a. Elster American Meter: www.elster-americanmeter.com/#sle.
   b. Omega Engineering a subsidiary of Spectris, Plc: www.omega.com/#sle.
   c. Substitutions: See *Division 01 60 00* - Product Requirements.
2. Utility Connection Size: 12 inches (300 mm, DN) flanged with upstream strainer.
3. Inline Type, Pipe Size: 1 inch (25 mm, DN) sweat or threaded connection.
4. Insertion Type, Pipe Size: 6 inch (150 mm, DN) with interfacing ball valve and threadolet.
5. Maximum Operating Line Pressure: 285 psi (20 bar).
6. Rangeability and Accuracy: 100 to 1 at plus or minus one percent.
7. Temperature Compensation: minus 30 to 140 degrees F (minus 34 to 60 degrees C).
8. Cast steel case with security seals, flanged piping connection, drain plug, pressure tap, hermetically sealed register, pressure compensation, restrictive orifice plate, reverse flow, and temperature compensation.

2.03 ENERGY METERS

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. Venture Measurement Company: www.venturemeasurement.com.
3. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Meter: Brass body turbine meter with magnetic drive register, platinum temperature sensors.
1. Maximum Service Temperature: 200 degrees F (93 degrees C).
2. Nominal Flow: _____gpm (_____L/sec).
3. Pressure Drop at Nominal Flow: _____psi (_____kPa).

4. Maximum Flow: _____gpm (_____L/sec).
5. Maximum Operating Pressure: _____psi (_____kPa).
6. Accuracy: 1-1/2 percent.
7. Maximum Counter Reading: 1 million btuh (kJ).
8. Size: 1/2 inch (15 mm, DN).
9. Power: Alkaline battery.

2.04 FLOWMETERS

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. McCrometer, Inc: www.mccrometer.com/#sle.
3. Venture Measurement Company: www.venturemeasurement.com.
4. VWR International, LLC: us.vwr.com/#sle.
5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. In-Line Monitor:
1. Material: 304 Stainless steel.
2. Accuracy: Plus or minus five percent full scale.
3. Provide 10-point NIST Calibration Certificate.
4. Flow: Water, flow-range as indicated on drawings.
5. Connection Size: 1 inch (25 mm, DN) NPT female.
6. Maximum Service Pressure: 200 psi (13.8 bar).
7. Maximum Service Temperature: 100 degrees F (54 degrees C).
8. Range marks to bear metric and English (dual) scale with gpm (L/min) units.

C. Flow Sensing Element.
1. In-Line Averaging Measuring Station: Type 316 stainless steel pitot type flow element inserted through welded threaded couplet, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
   a. Pressure rating: 275 psi (1896 kPa).
   b. Maximum temperature: 400 degrees F (204 degrees C).
   c. Accuracy: Plus 0.55 percent to minus 2.30 percent.
2. Venturi Fitting with Built-in Orifice Plate: Calibrated ASME MFC-3M venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gauge in case.
3. Portable Meter: Dry single diaphragm type pressure gauge with 6 inch (150 mm, DN) dial pointer, stainless steel wetted metal parts, variable pulsation damper, equalizing valve, two bleed valves, and master chart for direct conversion of meter readings to flow rate, mounted in rust-proof carrying case with two ten foot (3 m) long rubber test hoses with brass valves or quick connections for measuring stations.

2.05 PRESSURE GAUGES

A. Manufacturers:
1. Ashcroft, Inc: www.ashcroft.com/#sle.
2. Dwyer Instruments, Inc: www.dwyer-inst.com.
3. Moeller Instrument Co., Inc: www.moellerinstrument.com.
4. Omega Engineering, Inc: www.omega.com.
5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background. Pressure gages installed at pumps shall be liquid-filled case type.
1. Dial Size and Cover: 4-1/2-inch (115 mm) diameter scale with polycarbonate window.
2. Dial Text and Markings: Black color on white background with scaled kPa and psi units.
3. Accuracy: ASME B40.100, adjustable industrial grade (A) with 1 percent at mid-range of span.

C. Diaphragm Actuated for Gases:
1. Dial Size and Cover: 3-1/2-inch (90 mm) diameter scale with polycarbonate window.
2. Dial Text and Markings: Black color on white background with scaled cm (cm wg) and inch (in wg) units.

3. Accuracy: ASME B40.100, adjustable commercial grade (B) with 2 percent at mid-range of span.
4. Process Connection: Lower-back, 1/4-inch (8 mm, DN) NPT male except where noted.

D. Manometers: Inclined type, red oil on white background with black figures, front recalibration adjustment, 3 percent of full-scale accuracy.

E. Accessories:
1. Air or Gas Sensor: Static pressure with compression fittings for bulkhead mounting and 1/4-inch (6.35 mm) diameter tubing.
2. Gauge Cock: Carbon steel with tee or lever handle for maximum 150 psi (1034 kPa).
3. Needle Valve: Carbon steel, 1/4-inch (6 mm, DN) NPT female for noncorrosive service.
4. Coil Siphon: 213 seamless steel, 1/4-inch (8 mm, DN) NPT male for rated capacity.
5. Pressure Snubber (Pulsation Damper): Brass, 1/4-inch (8 mm, DN) NPT male.
6. Diaphragm Seal: 316L Stainless steel wetted material rated at 15 psi (1 bar), threaded. Select top size to match gauge size.

2.06 THERMOMETERS

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
3. Watts Water Technologies, Inc: www.watts.com/#sle.
4. Weiss Instruments, LLC: www.weissinstruments.com/#sle.
5. Winters Instruments: www.winters.com/#sle.
6. Substitutions: See *Division 01 60 00* - Product Requirements.

B. General:
1. Product Compliance: ASTM E1.
2. Lens: Clear glass, except where stated.
3. Accuracy: One percent, when tested in accordance with ASTM E77, except where stated.
4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.

C. Thermometers - Straight: 5-inch (127 mm) v-shape lead-free brass case with clear glass window scale, 2-inch (50.8 mm) NPT stem, 3-1/4-inch (82.5 mm) NPT thermowell, and red or blue non-toxic organic liquid filled glass tube.

D. Thermometers - Adjustable Angle: 7-inch (177.8 mm) v-shape aluminum case with clear glass window scale, 6-inch (152.4 mm) NPT stem, red or blue organic non-toxic liquid filled glass tube, and adjustable joint with positive locking device allowing 360 degrees in horizontal plane or 180 degrees in vertical plane adjustments.

E. Thermometers - Dial Type:
1. Fixed: 5-inch (125 mm) diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch (63.5 mm) NPT stem.
2. Adjustable Angle: 5-inch (125 mm) diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2-inch (63.5 mm) NPT stem.
3. Vapor (Gas) Actuated: 4-1/2-inch (115 mm) glass-reinforced phenolic case, aluminum dial with black pointer, recalibrating screw, 2-inch (50.8 mm) brass thermowell, adjustable joint with positive locking device allowing 180 degrees in vertical plane adjustment and capillary.
4. Manufacturers:
   a. Marshall Instruments, Inc: www.marshallinstruments.com/#sle.
   b. Reotemp Instruments Corp: reotemp.com/#sle.
   c. Wika Instrument, LP: www.wika.us/#sle.
   d. Substitutions: See *Division 01 60 00* - Product Requirements.

2.07 PRESSURE-TEMPERATURE TEST PLUGS:

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Watts Water Technologies, Inc: www.watts.com/#sle.
3. Weiss Instruments, LLC: www.weissinstruments.com/#sle.
4. Winters Instruments: www.winters.com/#sle.

5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Size: 500 psi (34.5 bar) capacity; 1/2-inch (13 mm) MPT brass fitting with gasket, cap, and retaining strap for 1/8-inch (3 mm) pressure gauge or temperature probe.

C. Wetted Materials per Temperature Range:
1. Up to 200 degrees F (93 degrees C): Brass probe with neoprene core.
2. 200 to 350 degrees F (93 to 176 degrees C): Brass probe with EPDM core.
3. 350 to 400 degrees F (176 to 204 degrees C): Brass probe with synthetic rubber core.

D. Accessories: Brass, lever-handle cock and snubber-filter.

E. Test Kit: Internally padded carrying case fitted with two 2-1/2-inch (60 mm) diameter pressure gauges, adapters, two 1/8-inch (3 mm) probes, and 1 inch (25 mm) dual-scale dial thermometers.

2.08 STRAINERS

A. "Y" Type:
1. 1/2" through 2": Muessco No. 11, iron body, 250-lb SWP, 400-lb WOG, monel or stainless steel screen, blow-off outlet, screwed ends.
2. 2-1/2" through 12": Muessco No.751, iron body, 125-lb SWP, 175-lb WOG, brass screen, blow-off outlet, flanged ends.

B. Basket type:
1. Muessco No. 155, cast iron: through 4", 60-lb WOG; 5" through 10", 40-lb WOG; 12" and larger, 150-lb WOG, brass screen, drain connection, flanged ends.

C. Screens - Water:
1. Brass.
2. Perforations: up to 2", 1/10" diameter, 49 per sq. in.; 2-1/2" to 4", 1/8" diameter, 32 per sq. in.; 5" and up, 1/4" diameter, 8 per sq. in.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install metering products in accordance with manufacturer's instructions.

B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.

C. Install gas meters in accordance with Utility Service Provider instructions with required appurtenances.

D. Install rotameters (flowmeters) between 4 to 6 ft (1.2 to 1.8 m) above finished floor unless instructed otherwise to allow easy readability.

E. Install pressure gauges as follows:
1. At Pumps: Place single gauge before strainer, suction side and discharge side.
2. Include gauge cock to isolate each gauge and extend nipples for insulation clearance.
3. Include siphons on high temperature systems and select type according to service rating.
4. Adjust gauges to selected viewing angles, clean thoroughly, and calibrate to zero.

F. Install thermometers as follows:
1. Hot Water Heaters: Place upstream and downstream of heater. Add one on the inlet end when using steam as the water heating medium.
2. Piping: Install thermometers in branch butt weld connection fitting or socket-weld thermowell. Enlarge pipes smaller than 2-1/2 inches (60 mm) to accommodate sockets. Ensure sockets are above insulation clearance.

G. Locate PT (pressure-temperature) test plugs adjacent to control device sockets.

H. Provide thermometers in inlet and outlet piping of hot water at boilers, hot water and cold water at water heaters, and elsewhere as indicated on Drawings.

I. Provide gages on inlet and outlet piping of all pumps, except domestic hot water circulators, and elsewhere as indicated on Drawings.

J. Thermometers and gauges shall be arranged so they might be read standing in a normal position of the floor.

K. Provide test plugs on inlet and outlet piping of all heat exchange equipment.

L. Locate gages, thermometers and test plugs as close as possible to equipment being monitored.

3.02 SCHEDULES

A. Pressure Gauges, Location and Scale Range:
1. Pumps, 0 to _____psi (0 to _____kPa).

2. Expansion tanks, 0 to _____psi (0 to _____kPa).
3. Pressure tanks, 0 to _____psi (0 to _____kPa).
4. Standpipe, highest points, 0 to _____psi (0 to _____kPa).
5. Standpipe and sprinkler water supply connection, 0 to _____psi (0 to _____kPa).
6. Sprinkler system, 0 to _____psi (0 to _____kPa).
7. Pressure reducing valves, 0 to _____psi (0 to _____kPa).
8. Backflow preventers, 0 to _____psi (0 to _____kPa).

B. Pressure Gauge Tappings, Location:
1. Control valves 3/4 inch (20 mm) & larger - inlets and outlets.
2. Major coils - inlets and outlets.
3. Heat exchangers - inlets and outlets.

C. Stem Type Thermometers, Location and Scale Range:
1. Headers to central equipment, 0 to _____degrees F (0 to _____degrees C).
2. Coil banks - inlets and outlets, 0 to _____degrees F (0 to _____degrees C).
3. Heat exchangers - inlets and outlets, 0 to _____degrees F (0 to _____degrees C).
4. Domestic hot water supply and recirculation, 0 to _____degrees F (0 to _____degrees C).

D. Thermometer Sockets, Location:
1. Control valves 1 inch (25 mm) & larger - inlets and outlets.
2. Reheat coils - inlets and outlets.
3. Cabinet heaters - inlets and outlets.
4. Unit heaters - inlets and outlets.

E. Dial Thermometers, Location and Scale Range:
1. Each supply air zone, 0 to _____degrees F (0 to _____degrees C).
2. Outside air, 0 to _____degrees F (0 to _____degrees C).
3. Return air, 0 to _____degrees F (0 to _____degrees C).
4. Mixed air, 0 to _____degrees F (0 to _____degrees C).

DIVISION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Applications.
B. General requirements.
C. Angle valves.
D. Ball valves.
E. Butterfly valves.
F. Check valves.
G. Gate valves.
H. Globe valves.
I. Plug valves.
J. Chainwheels.

1.02 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
C. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2013.
D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022, with Errata (2023).
E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.
G. ASME B31.9 - Building Services Piping; 2014.
H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
I. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
J. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).
K. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.

L. AWWA C606 - Grooved and Shouldered Joints; 2011.
M. MSS SP-45 - Drain and Bypass Connections; 2020.
N. MSS SP-67 - Butterfly Valves; 2022.
O. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
P. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
Q. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
R. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
    1. See *Division 01 60 00* - Product Requirements for additional provisions.

1.04 QUALITY ASSURANCE

A. Manufacturer:
    1. Obtain valves for each valve type from single manufacturer.
    2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
    1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
    2. Protect valve parts exposed to piped medium against rust and corrosion.
    3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
    4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
    5. Secure check valves in either the closed position or open position.
    6. Adjust butterfly valves to closed or partially closed position.
B. Use the following precautions during storage:
    1. Maintain valve end protection and protect flanges and specialties from dirt.
        a. Provide temporary inlet and outlet caps.
        b. Maintain caps in place until installation.
    2. Store valves in shipping containers and maintain in place until installation.
        a. Store valves indoors in dry environment.
        b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. See drawings for specific valve locations.
B. Provide the following valves for the applications if not indicated on drawings:
    1. Shutoff: Ball, butterfly, or gate.
    2. Dead-End: Ball, gate, or Single-flange butterfly (lug) type.
    3. Throttling: Provide globe, angle, or ball.
    4. Swing Check (Pump Outlet):
        a. 2 NPS (50 DN) Bronze swing check valves with bronze or nonmetallic disc and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
        b. 2-1/2 NPS and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
C. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
B. Valve Sizes: Match upstream piping unless otherwise indicated.
C. Valve Actuator Types:
   1. Gear Actuator: Quarter-turn valves 8 inches (200 mm, DN) and larger.
   2. Handwheel: Valves other than quarter-turn types.
   3. Hand Lever: Quarter-turn valves 6 inches (150 mm, DN) and smaller except plug valves.
   4. Wrench: Plug valves with square heads.
   5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
D. Insulated Piping Valves: With 2-inch (50 mm, DN) stem extensions and the following features:
   1. Gate Valves: Rising stem.
   2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   3. Butterfly Valves: Extended neck.
   4. Memory Stops: Fully adjustable after insulation is installed.
E. Valve-End Connections:
   1. Threaded End Valves: ASME B1.20.1.
   2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
   3. Pipe Flanges and Flanged Fittings 1/2 inch (15 mm, DN) through 24 inch (600 mm, DN): ASME B16.5.
   4. Solder Joint Connections: ASME B16.18.
   5. Grooved End Connections: AWWA C606.
F. General ASME Compliance:
   1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
   2. Solder-joint Connections: ASME B16.18.
   3. Building Services Piping Valves: ASME B31.9.
G. Valve Materials for Potable Water: NSF 61 and NSF 372.
H. Bronze Valves:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.
I. Valve Bypass and Drain Connections: MSS SP-45.

2.03 BRONZE, ANGLE VALVES

A. Class 125: CWP Rating: 200 psig: (1380 kPa).
   1. Comply with MSS SP-80, Type 1.
   2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
   3. End Connections: Pipe thread.
   4. Stem: Bronze.
   5. Disc: Bronze.
   6. Packing: Asbestos free.
   7. Handwheel: Bronze or aluminum.

2.04 BRASS, BALL VALVES

A. Three Piece, Full Port with Stainless Steel Trim:
   1. Comply with MSS SP-110.
   2. WSP Rating: 150 psi (1035 kPa).
   3. CWP Rating: 600 psi (4140 kPa).
   4. Body: Forged brass.
   5. Ends: Threaded.
   6. Seats: PTFE.
   7. Stem: Stainless steel.
   8. Ball: Stainless steel, vented.
   9. Manufacturers:
      a. Ferguson Enterprises Inc: www.fnw.com/#sle.
      b. Substitutions: See *Division 01 60 00* - Product Requirements.

2.05 BRONZE, BALL VALVES

A. One Piece, Reduced Port with Bronze Trim:
   1. Comply with MSS SP-110.
   2. WSP Rating: 400 psi (2760 kPa).
   3. CWP Rating: 600 psi (4140 kPa).
   4. Body: Bronze.
   5. End Connections: Pipe press.
   6. Seats: PTFE.
   7. Stem: Bronze.
   8. Ball: Chrome plated brass.
   9. Manufacturers:
      a. Apollo Valves: www.apollovalves.com/#sle..
      b. FNW: www.fnw.com/#sle..
      c. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle..
      d. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Three Piece, Full Port with Stainless Steel Trim:
   1. Comply with MSS SP-110.
   2. WSP Rating: 150 psi (1035 kPa).
   3. CWP Rating: 600 psi (4140 kPa).
   4. Body: Bronze.
   5. Ends: Threaded.
   6. Seats: PTFE
   7. Stem: Stainless steel.
   8. Ball: Stainless steel, vented.
   9. Manufacturers:
      a. Apollo Valves: www.apollovalves.com/#sle.
      b. Viega LLC: www.viega.com/#sle.
      c. Substitutions: See *Division 01 60 00* - Product Requirements.

2.06 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug Style; Bi-directional dead-end service without use of downstream flange:
   1. Comply with MSS SP-67, Type I.
   2. CWP Rating: 200 psig.
   3. Body: ASTM A126, cast iron or ASTM A536, ductile iron.
   4. Stem: One or two-piece stainless steel.
   5. Seat: EPDM.
   6. Disc: Coated ductile iron.
   7. Manufacturers:
      a. Apollo Valves: www.apollovalves.com/#sle.
      b. Substitutions: See *Division 01 60 00* - Product Requirements.

2.07 BRONZE, LIFT CHECK VALVES

A. Class 125:
   1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
   2. CWP Rating: 200 psi (1380 kPa).
   3. Design: Vertical flow.
   4. Body: Comply with ASTM B61 or ASTM B62, bronze.
   5. End Connections: Threaded.
   6. Disc (Type 1): Bronze.

2.08 BRONZE, SWING CHECK VALVES

A. Class 125: CWP Rating: 200 psig (1380 kPa).
   1. Comply with MSS SP-80, Type 3.
   2. Design: Horizontal flow.
   3. Body: Bronze, ASTM B62.
   4. End Connections: Threaded as indicated.
   5. Disc: Bronze.
   6. Manufacturers:

a. Apollo Valves: www.apollovalves.com/#sle.
b. Substitutions: See *Division 01 60 00* - Product Requirements.

2.09 IRON SWING CHECK VALVES

A. Class 125:
1. Comply with MSS SP-71, Type I.
2. CWP Rating: 200 psi (1380 kPa).
3. Design: Clear or full waterway.
4. Body: ASTM A126, gray cast iron with bolted bonnet.
5. Ends: Flanged as indicated.
6. Trim: Composition.
7. Seat Ring and Disc Holder: Bronze.
8. Disc: PTFE.
9. Gasket: Asbestos free.
10. Manufacturers:
a. Apollo Valves: www.apollovalves.com/#sle.
b. Ferguson Enterprises Inc: www.fnw.com/#sle.
c. Flomatic Valves: www.flomatic.com/#sle.
d. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Class 250:
1. Comply with MSS SP-71, Type I.
2. CWP Rating: 500 psi (3450 kPa).
3. Design: T-body style for clear or full waterway.
4. Body: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged as indicated.
6. Trim: Bronze.
7. Metal Seat.
8. Gasket: Asbestos free.

2.10 BRONZE, GATE VALVES

A. Rising Stem (RS):
1. Comply with MSS SP-80, Type I.
2. Class 125: CWP Rating: 200 psig.
3. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
4. Ends: Threaded or solder joint
5. Stem: Bronze.
6. Disc: Solid wedge; bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron, bronze, or aluminum.
9. Manufacturers:
a. Apollo Valves: www.apollovalves.com/#sle.
b. Ferguson Enterprises Inc: www.fnw.com/#sle.
c. Substitutions: See *Division 01 60 00* - Product Requirements.

2.11 IRON, GATE VALVES

A. OS & Y:
1. Pressure and Temperature Rating: MSS SP-70, Type I.
2. Comply with MSS SP-70, Type I.
3. Class 125: CWP Rating: 200 psig:.
4. Body: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Bronze.
7. Disc: Solid wedge.
8. Packing and Gasket: Asbestos free.
9. Manufacturers:
a. Apollo Valves: www.apollovalves.com/#sle.
b. Ferguson Enterprises Inc: www.fnw.com/#sle.
c. Substitutions: See *Division 01 60 00* - Product Requirements.

2.12 BRONZE, GLOBE VALVES

A. Class 125: CWP Rating: 200 psig.
   1. Comply with MSS SP-80, Type 1.
   2. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
   3. End Connections: Threaded joint.
   4. Stem: Bronze.
   5. Disc: PTFE.
   6. Packing: Asbestos free.
   7. Handwheel Operator: Malleable iron.
   8. Manufacturers:
      a. Apollo Valves: www.apollovalves.com/#sle.
      b. Substitutions: See *Division 01 60 00* - Product Requirements.

2.13 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
   1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
   2. Attachment: For connection to ball valve stems.
   3. Sprocket Rim with Chain Guides: Ductile iron. Include zinc coating.
   4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interiors, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.
B. Verify valve parts to be fully operational in all positions from closed to fully open.
C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
D. Should valve is determined to be defective, replace it with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
D. Install check valves where necessary to maintain direction of flow as follows:
   1. Lift Check: Install with stem plumb and vertical.
   2. Swing Check: Install horizontal maintaining hinge pin level.
   3. Orient plate-type into horizontal or vertical position, between flanges.
E. Provide chainwheels on operators for valves 4 NPS and larger where located 96 NPS or more above finished floor, terminating 60 NPS above finished floor.

DIVISION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Equipment support bases.
B. Vibration isolators.
C. Seismic snubber assemblies.
D. Seismic restraints for suspended components and equipment.

1.02 RELATED REQUIREMENTS

A. Code-Required Special Inspections: Statement of Special Inspections; additional requirements for code-required special inspections.
B. *Division 03 30 00* - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
C. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
D. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
E. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
G. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
H. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data:
   1. Provide manufacturer's product literature documenting compliance with PART 2 PRODUCTS.
   2. Include seismic rating documentation for each isolator and restraint component accounting for horizontal, vertical, and combined loads.
C. Shop Drawings:
   1. Provide schedule of vibration isolator type with location and load on each.
   2. Fully dimensioned fabrication drawings and installation details for vibration isolation bases, member sizes, attachments to isolators, and supported equipment.
   3. Include auxiliary motor slide bases and rails, base weights, inertia bases, concrete weights, equipment static loads, support points, vibration isolators, and detailed layout of isolator location and orientation with static and dynamic load on each isolator.
   4. Include selections from prescriptive design tables that indicate compliance with the applicable building code and the vibration isolator manufacturer's requirements.
   5. Clearly indicate the load and capacity assumptions selected. Include copies of any calculations.
   6. Include the calculations that indicate compliance with the applicable building code for seismic controls and the vibration isolator manufacturer's requirements.
   7. Include the seal of the Professional Engineer registered in the State of Tennessee on the drawings and calculations which at a minimum include the following:
      a. Seismic Restraint Details: Detailed drawings of seismic restraints and snubbers including anchorage details that indicate quantity, diameter, and depth of penetration, edge distance, and spacing of anchors.
      b. Equipment Seismic Qualification Certification: Certification by the manufacturer or responsible party that each piece of equipment provided will withstand seismic force levels as specified in the applicable building code for seismic controls.
         1) Basis for Certification: Indicate whether the withstand certification is based on actual testing of assembled components, on calculations, or on historic data.
         2) Indicate equipment to be sufficiently durable to resist design forces and or remain functional after the seismic event.
      c. Dimensioned outline drawings of equipment identifying center of gravity, locations, and provisions for mounting and anchorage.
      d. Detailed description of the equipment anchorage devices on which the certifications are based.
      e. Statement of Special Inspections: Prepared by the registered design professional in responsible charge.
D. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

1.05 QUALITY ASSURANCE

A. Perform design and installation in accordance with applicable codes.
B. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and registered and licensed in the State in which the Project is located.
C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1. Member of Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of experience.

E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
   1. See Code-Required Special Inspections.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Kinetics Noise Control, Inc
B. Mason Industries
C. Vibration Eliminator Company, Inc
D. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. General:
   1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.
   2. Steel springs to function without undue stress or overloading.
   3. Steel springs to operate in the linear portion of the load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
   4. Lateral to vertical stiffness ratio to not exceed 0.08 with spring deflection at minimum 75 percent of specified deflection.
   5. All equipment mounted on vibration isolated bases to have minimum operating clearance of 2 inches (50.8 mm) between the base and floor or support beneath unless noted otherwise.

2.03 EQUIPMENT SUPPORT BASES

A. Structural Bases:
   1. Construction: Engineered, structural steel frames with welded brackets for side mounting of the isolators.
   2. Frames: Square, rectangular or T-shaped.
   3. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
   4. Applications: Adjustable motor slide rails for centrifugal fans.

B. Concrete Inertia Bases:
   1. Construction: Engineered, steel forms, with integrated isolator brackets and anchor bolts, welded or tied reinforcing bars running both ways in a single layer.
   2. Size: 6 inches (152.4 mm) minimum depth and sized to accommodate elbow supports.
   3. Mass: Minimum of 1.5 times weight of isolated equipment.
   4. Connecting Point: Reinforced to connect isolators and snubbers to base including template and fastening devices for equipment.
   5. Concrete: Filled on site with minimum 3000 psi (20684.28 kPa) concrete. See *Division 03 30 00* for additional requirements.
   6. Applications: Adjustable motor slide rails for centrifugal fans.

2.04 VIBRATION ISOLATORS

A. Non-Seismic Type:
   1. All Elastomeric-Fiber Glass Pads:
      a. Configuration: Flat or molded.
      b. Thickness: 0.25 inch (6.35 mm) minimum.
      c. Assembly: Single or multiple layers using bonded, galvanized sheet metal separation plate between each layer with load plate providing evenly distributed load over pad surface.
   2. Elastomeric Mounts:
      a. Material: Oil, ozone, and oxidant resistant compounds.
      b. Assembly: Encapsulated load transfer plate bolted to equipment and base plate with anchor hole bolted to supporting structure.
   3. Steel Springs:
      a. Assembly: Freestanding, laterally stable without housing.
      b. Leveling Device: Rigidly connected to equipment or frame.

4. Restrained Steel Springs:
    a. Housing: Rigid blocking during rigging prevents equipment installed and operating height from changing during temporary weight reduction.
    b. Equipment Wind Loading: Adequate means for fastening isolator top to equipment and isolator base plate to supporting structure.
5. Elastomeric Hangers:
    a. Housing: Steel construction containing elastomeric isolation element to prevent rod contact with housing and short-circuiting of isolating function.
    b. Incorporate steel load distribution plate sandwiching elastomeric element to housing.
6. Spring Hanger:
    a. Housing: Steel construction containing stable steel spring and integral elastomeric element preventing metal to metal contact.
    b. Bottom Opening: Sized to allow plus/minus 15 degrees rod misalignment.
7. Combination Elastomeric-Spring Hanger:
    a. Housing: Steel construction containing stable steel spring with elastomeric element in series isolating upper connection of hanger box to building structure.
    b. Bottom Opening: Sized to allow plus/minus 15 degrees rod misalignment.
8. Thrust Restraints:
    a. Housing: Steel construction containing stable steel spring and integral elastomeric elements installed in pairs to resist air pressure thrusts.
    b. Bottom Openings: Sized to allow plus/minus 15 degrees rod misalignment.

B. Seismic Type:
1. Coil Springs Consisting of Single Elements:
    a. Housing: Manufactured from cast iron material.
    b. Ductile Material: Designed and rated for seismic applications.
    c. Spring: Restrained by housing without significant degradation of vibration isolation capabilities during normal equipment operating conditions.
    d. Resilient Snubbing Grommet System: Incorporated and designed with clearances of no more than 0.25 inch (6.35 mm) in any direction preventing direct metal-to-metal contact between supported member and fixed restraint housing.
    e. Resilient Pad: Located in series with spring.
    f. Coil Springs: Color coded elements to have a lateral stiffness greater than 0.8 times the rated vertical stiffness with 50 percent overload capacity.
    g. Finish: Suitable for the application.
2. All Directional Elastomeric:
    a. Material: Molded from oil, ozone, and oxidant resistant compounds.
    b. Operating Parameters: Designed to operate within the isolator strain limits providing maximum performance and service life.
    c. Attachment Method: Encapsulated load transfer plate bolted to equipment and base plate with anchor hole bolted to supporting structure.
    d. Rating: Cast iron and aluminum housings rated for seismic restraint applications.
    e. Minimum Operating Static Deflections: Deflections indicated in project documents are not to exceed published load capacities.

2.05 SEISMIC SNUBBER ASSEMBLIES

A. Comply with:
1. ASHRAE (HVACA) Handbook - HVAC Applications.
2. FEMA 412.
3. FEMA 413.
4. FEMA 414.
5. FEMA E-74.
6. SMACNA (SRM).

B. All Directional External:
1. Application: Minimum three (3) snubbers are required for each equipment installation, oriented properly to restrain isolated equipment in all directions.
2. Construction: Interlocking steel construction attached to the building structure and equipment in a manner consistent with anticipated design loads.

3. Performance: Equipment movement at each snubber location limited to a maximum of inches in any direction without significantly degrading the vibration isolation capability of the isolator during normal operating conditions.
4. Resilient Pad: Minimum 0.25 inch (6.35 mm) thick cushions any impact and prevents metal-to-metal contact.

C. Lateral External:
1. Application: Minimum three (3) snubbers are required for each stable equipment installation, oriented properly to restrain isolated equipment in all lateral directions where uplift forces are zero or addressed by other restraints.
2. Construction: Steel construction attached to the building structure and equipment in a manner consistent with anticipated design loads.
3. Performance: Equipment movement at each snubber location limited to a maximum of 0.25 inches in any direction without significantly degrading the vibration isolation capability of the isolator during normal operating conditions.
4. Resilient Pad: Minimum 0.25 inch (6.35 mm) thick cushions any impact and prevents metal-to-metal contact.

D. Omni Directional External:
1. Application: Minimum four (4) snubbers are required for each stable equipment installation, oriented properly to restrain isolated equipment in all lateral directions.

E. Construction: Steel construction attached to the building structure and equipment in a manner consistent with anticipated design loads.
1. Performance: Equipment movement at each snubber location limited to a maximum of 0.25 inches in any direction without significantly degrading the vibration isolation capability of the isolator during normal operating conditions.
2. Resilient Pad: Minimum 0.25 inch (6.35 mm) thick cushions any impact and prevents metal-to-metal contact.

F. Horizontal Single Axis External:
1. Application: Minimum four (4) snubbers are required for each stable equipment installation, oriented properly to restrain isolated equipment in all lateral directions where uplift forces are zero or addressed by other restraints.
2. Construction: Steel construction attached to the building structure and equipment in a manner consistent with anticipated design loads.
3. Performance: Equipment movement at each snubber location limited to a maximum of 0.25 inches in any direction without significantly degrading the vibration isolation capability of the isolator during normal operating conditions.

G. Resilient Pad: Minimum 0.25 inch (6.35 mm) thick cushions any impact and prevents metal-to-metal contact.

2.06 SEISMIC RESTRAINTS FOR SUSPENDED COMPONENTS AND EQUIPMENT

A. Comply with:
1. ASHRAE (HVACA) Handbook - HVAC Applications.

B. FEMA 412.
C. FEMA 413.
D. FEMA 414.
E. FEMA E-74.
F. SMACNA (SRM).
G. Cable Restraints:
1. Wire Rope: Steel wire strand cables sized to resist seismic loads in all lateral directions.
2. Protective Thimbles: Eliminates potential for dynamic cable wear and strand breakage.
3. Size: Based on the lesser of cable capacity or anchor load taking into account bracket geometry.
4. Connections:
a. Use overlapping wire rope U clips, cable clamping bolts, swaged sleeves or seismically rated tool-less wedge insert lock connectors.
b. Internally brace clevis hanger bracket cross bolt to prevent deformation.
5. Vertical Suspension Rods: Attach required bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.

2.07 ROOF CURBS

A. Vibration Isolation Curbs:
   1. Non-Seismic Curb Rail:
      a. Location: Between existing roof curb and rooftop equipment.
      b. Construction: Aluminum.
      c. Integral vibration isolation to conform to requirements of this section.
      d. Weather exposed components consist of corrosion resistant materials.
   2. Non-Seismic Curb:
      a. Location: Between structure and rooftop equipment.
      b. Construction: Aluminum.
      c. Integral vibration isolation to conform to requirements of this section.
      d. Weather exposed components consist of corrosion resistant materials.
   3. Seismic Curb:
      a. Location: Between structure and rooftop equipment.
      b. Construction: Steel.
      c. Integral vibration isolation to conform to requirements of this section.
      d. Snubbers consist of minimum 0.25 inch (6.35 mm) thick resilient pads to avoid metal-to-metal contact without compromising vibration isolating capabilities.
      e. Weather exposed components consist of corrosion resistant materials.

B. Seismic Type Non-Isolated Curb and Fabricated Equipment Piers:
   1. Location: Between structure and rooftop equipment.
   2. Construction: Steel.
   3. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions.

B. Bases:
   1. Set steel bases for one inch clearance between housekeeping pad and base.
   2. Set concrete inertia bases for 4 inches (101.6 mm) clearance between housekeeping pad and base.
   3. Adjust equipment level.

C. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

D. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

E. Provide pairs of horizontal limit springs on fans with more than 6.0 inches (152.4 mm) WC static pressure, and on hanger supported, horizontally mounted axial fans.

F. Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.
   1. Up to 4 Inches Pipe Size: First three points of support.
   2. 5 to 8 Inches Pipe Size: First four points of support.
   3. 10 inches (254 mm) Pipe Size and Over: First six points of support.
   4. Select three hangers closest to vibration source for minimum 1.0 inch (25.4 mm) static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.02 INSTALLATION - SEISMIC

A. Comply with:
   1. ASHRAE (HVACA) Handbook - HVAC Applications.
   2. FEMA 412.
   3. FEMA 413.
   4. FEMA 414.
   5. FEMA E-74.
   6. SMACNA (SRM).

B. Seismic Snubbers:
   1. Provide on all isolated equipment, piping and ductwork.
   2. Provide minimum of four seismic snubbers located close to isolators.

3. Snub equipment designated for post-disaster use to 0.05 inch (1.27 mm) maximum clearance.
4. Snub all other equipment between 0.15 inch (3.81 mm) and 0.25 inch (6.35 mm) clearance.

C. Floor and Base-Mounted Equipment, Vibration Isolated Equipment and associated Vibration and Seismic Controls for Connections:
1. Install equipment anchorage items designed to resist seismic design force in any direction.
2. Install vibration and seismic controls designed to include base and isolator requirements.
3. Provide flexible connections between equipment and interconnected piping.
4. Provide isolators and restraints designed for amplified code forces per ASCE 7 and with demonstrated ability to resist required forces including gravity, operational and seismic forces.
5. Where equipment is not designed to be point loaded, provide base capable of transferring gravity and seismic demands from equipment to isolator base plate anchorage.
6. Where concrete floor thickness is less than required for expansion anchor installation, install through bolt in lieu of expansion anchor.
7. Where timber/wood floor or other substrate is inadequate for installation of lag bolts, screws or other mechanical fasteners, install supplemental framing or blocking to transfer loads to structural elements.

D. Suspended Mechanical Equipment:
1. Provide supports and bracing to resist seismic design force in any direction.
2. Provide flexible connections between equipment and interconnected piping.
3. Brace equipment hung from spring mounts using cable or other bracing that will not transmit vibration to the structure.
4. Use of proprietary restraint systems with a certificate of compliance, verified and listed by an accredited inspection body is acceptable (pending shop drawing approval), as an alternative to project specific seismic bracing design.

E. Wall mounted Mechanical Equipment:
1. Provide support and bracing to resist seismic design force in any direction.
2. Install backing plates or blocking as required to deliver load to primary wall framing members.
3. Anchoring to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads is not permitted.

F. Piping:
1. Provide seismic bracing in accordance ASCE 7.
2. Provide supports, braces, and anchors to resist gravity and seismic design forces.
3. Provide flexible connections between floor mounted equipment and suspended piping; between unbraced piping and restrained suspended items; as required for thermal movement; at building separations and seismic joints; and wherever relative differential movements could damage pipe in an earthquake.
4. Brace resiliently supported pipe with cable bracing or alternate means designed to prevent transmission of vibrations and noise to the structure.
5. Brace every run 5.0 feet (152.4 cm) or more in length with two transverse and one longitudinal bracing locations.
6. Pipes and Connections Constructed of Ductile Materials (copper, ductile iron, steel or aluminum and brazed, welded or screwed connections):
    a. Provide transverse bracing at spacing not more than 40.0 feet (1219.2 cm) on center.
    b. Provide longitudinal bracing at spacing not more than 80.0 feet (2438.4 cm) on center.
7. Pipes and Connections Constructed of Non Ductile Materials (cast iron, no-hub, plastic or non-UL listed grooved coupling pipe):
    a. Provide transverse bracing at spacing not more than 20.0 feet (609.6 cm) on center.
    b. Provide longitudinal bracing at spacing not more than 40.0 feet (1219.2 cm) on center.
8. Provide lateral restraint for risers at not more than 30 feet (914.4 cm) on center or as required for horizontal runs, whichever is less.
9. Piping Explicitly Exempt from Seismic Bracing Requirements:
    a. Provide flexible connections between piping and connected equipment.
    b. Install piping consistent with ASCE 7, such that swinging of the pipes will not cause

damaging impact with adjacent components, finishes, or structural framing while maintaining clear horizontal distance of 67 percent of the hanger length between subject components.

c. Provide swing restraints as required to control potential impact due to limited space between subject components.

10. Use of proprietary restraint systems with a certificate of compliance, verified and listed by an accredited inspection body is acceptable (pending shop drawing approval), as an alternative to project specific seismic bracing design.
11. Re-use of Existing Hangers:
    a. Unless otherwise shown on the drawings, it is assumed all hangers supporting new piping, located at a seismic brace, will be new.

G. Tanks:
1. Install tank anchorage, tank legs and/or supporting structure designed to resist design force.
2. Provide flexible connections between tank and interconnected piping.

3.03 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Inspect isolated equipment after installation and submit report. Include static deflections.
C. Perform testing and inspections of the installation in accordance with Code-Required Inspections/Special Inspections.

DIVISION 22 05 53 - PLUMBING IDENTIFICATION

PART 1 GENERAL

Use same identification system throughout project.

PIPE MARKERS AND FLOW ARROWS: Specify stencil paint type. Pipes to be labeled include but are not limited to Cold Water, Hot Water, Hot Water HVAC supply, Cold Water HVAC supply, Natural Gas, and Fire Suppression.

UNDERGROUND PLASTIC PIPE MARKER: Specify 6” wide x 4mil thick multi-ply tape, solid aluminum foil-core between 2 layers of plastic tape.
VALVE TAGS: Specify 19 gage polished brass valve tags.

All underground PVC plumbing, either water supply or drain to have tracer wire installed with it for future locating of pipes below grade.

ENGRAVED PLASTIC LAMINATE SIGN: Specify 1/16” thick fastened with self-tapping stainless steel screws.
Locate pipe markers and flow arrows as follows:

- Maximum of 25' & closer if congested.
- Near each valve
- Near each branch
- Near equipment
- Near origination & termination points
- Near where pipe passes through walls (both sides of wall)
- Near access doors

1.01 SECTION INCLUDES

A. Nameplates.
B. Tags.
C. Stencils.
D. Pipe markers.
E. Ceiling tacks.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
D. Product Data: Provide manufacturers catalog literature for each product required.
E. Samples: Submit two labels for each proposed.
F. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
G. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Automatic Controls: Tags. Key to control schematics.
B. Control Panels: Nameplates.
C. Heat Transfer Equipment: Nameplates.
D. Instrumentation: Tags.
E. Major Control Components: Nameplates.
F. Piping: Pipe markers.
G. Pumps: Nameplates.
H. Relays: Tags.
I. Small-sized Equipment: Tags.
J. Tanks: Nameplates.
K. Thermostats and Thermometers: Nameplates.
L. Valves: Tags and ceiling tacks where located above lay-in ceiling.
M. Water Treatment Devices: Nameplates.

2.02 NAMEPLATES

A. Manufacturers:
   1. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   2. Seton Identification Products: www.seton.com.
   3. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch (6 mm).
   3. Background Color: Black.
   4. Plastic: Conform to ASTM D709.

2.03 TAGS

A. Manufacturers:
   1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
   2. Brady Corporation: www.bradycorp.com.
   3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   4. Seton Identification Products: www.seton.com.
   5. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com.
   2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   3. Seton Identification Products: www.seton.com.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Stencils: With clean cut symbols and letters of following size:
   1. 3/4 to 1-1/4-inch (20 to 30 mm) Range: 1/2-inch (15 mm) text over 8 inch (200 mm) long background.
   2. 1-1/2-to-2-inch (40 to 50 mm) Range: 3/4-inch (20 mm) text over 8 inch (200 mm) long background.
   3. 2-1/2-to-6-inch (65 to 150 mm) Range: 1-1/4-inch (30 mm) text over 12 inch (300 mm) long background.

4. 8-to-10-inch (200 to 250 mm) Range: 2-1/2-inch (65 mm) text over 24 inch (600 mm) long background.
5. Over 10 inches (250 mm): 3-1/2-inch (90 mm) text over 32 inch (800 mm) long background.
6. Ductwork and Equipment: 2-1/2-inch-high letters.

C. Stencil Paint: As specified in *Division 09 91 23*, semi-gloss enamel, colors complying with ASME A13.1.

2.05 PIPE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradycorp.com.
2. MIFAB, Inc: www.mifab.com.
3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
4. Seton Identification Products: www.seton.com.
5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Comply with ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

F. Color code as follows:
1. Potable, Cooling, Boiler, Feed, Other Water: Green with white letters.
2. Toxic and Corrosive Fluids: Orange with black letters.
3. Flammable Fluids: Yellow with black letters.
4. Combustible Fluids: Brown with white letters.
5. Compressed Air: Blue with white letters.

2.06 CEILING TACKS

A. Manufacturers:
1. Craftmark: www.craftmarkid.com.
2. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Description: Steel with 3/4-inch (20 mm) diameter color coded head.

C. Color code as follows:
1. Plumbing Valves: Green.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with *Division 09 91 23* for stencil painting.

3.02 INSTALLATION

A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Apply stencil painting in accordance with *Division 09 91 23*.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.

F. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.

G. Use tags on piping 3/4 inch diameter and smaller.
1. Identify service, flow direction, and pressure.
2. Install in clear view and align with axis of piping.
3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

H. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

DIVISION 22 07 00 - PLUMBING INSULATION

PART 1 GENERAL

Insulate all domestic water piping as required by code. Minimum MSCS requirement shall be with 1" thick minimum except 1 1/2" for re-circulation hot water. Insulate roof leader horizontal piping with 1" thick insulation to include roof drain pan and vertical piping from roof drain. Install rigid jackets on all exposed insulated lines within 8' above floor in occupied spaces.

FIBERGLAS INSULATION: ASTM C 547 class I with type I all-service jacket.
EXPOSED INSULATION: Specify 8-ounce canvas rosin sized cloth jacket.
FITTINGS: one-piece pre-molded PVC fitting covers.

1.01 SECTION INCLUDES

A. Piping insulation.
B. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

A. *Division 07 84 00* - Firestopping.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
C. Samples: Submit two samples of any representative size illustrating each insulation type.
D. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.
C. Insulation specified is intended to set a standard. Insulation by other manufacturers will be considered provided that characteristics meet or exceed specified material. Each substitute item shall be submitted for approval.
D. Insulating materials shall comply with flame spread, smoke developed, and other applicable requirements of local and state Fire Codes and NFPA 90A, UL 723 or ASTM E-84. Before applying any insulation, submit satisfactory evidence of this compliance.
E. It is the intent of this Section of the Specifications that all cold surfaces subject to "sweating" shall be insulated and have a vapor barrier applied
F. Installer Qualifications: Insulation contractor installing this insulation system must be experienced with similar type systems and products.
G. Furnish insulation thickness in excess of that specified herein if so indicated on the drawings.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.
B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com.
   2. Johns Manville Corporation: www.jm.com.
   3. Knauf Insulation: www.knaufinsulation.com/#sle.
   4. Owens Corning Corporation: www.ocbuildingspec.com.
   5. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.

1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
2. Maximum Service Temperature: 850 degrees F (454 degrees C).
3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm (0.029 ng/(Pa s m)).

D. Tie Wire: 0.048-inch (1.22 mm) stainless steel with twisted ends on maximum 12-inch (300 mm) centers.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.
1. Manufacturers:
   a. Knauf Insulation; www.knaufusa.com.
   b. Johns Manville; www.jm.com.
   c. Owens Corning Corporation; www.ocbuildingspec.com.
   d. CertainTeed Corporation; www.certainteed.com.
   e. Substitutions: See *Division 01 60 00* - Product Requirements.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
1. Manufacturers:
   a. Knauf Insulation; www.knaufusa.com.
   b. Johns Manville; www.jm.com.
   c. Owens Corning Corporation; www.ocbuildingspec.com.
   d. Substitutions: See *Division 01 60 00* - Product Requirements.

G. Fibrous Glass Fabric:
1. Manufacturers:
   a. Knauf Insulation; www.knaufusa.com.
   b. Johns Manville; www.jm.com.
   c. Owens Corning Corporation; www.ocbuildingspec.com.
   d. Substitutions: See *Division 01 60 00* - Product Requirements.
2. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
3. Blanket: 1.0 pcf (16 kg/cu m) density.
4. Weave: 5 by 5.

H. Indoor Vapor Barrier Finish:
1. Manufacturers:
   a. Knauf Insulation.
   b. Johns Manville.
   c. Owens Corning Corp.
   d. Substitutions: See *Division 01 60 00* - Product Requirements.
2. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
3. Vinyl emulsion type acrylic, compatible with insulation, black color.

I. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
1. Manufacturers:
   a. Knauf Insulation.
   b. Johns Manville.
   c. Owens Corning Corp.
   d. Substitutions: See *Division 01 60 00* - Product Requirements.

J. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
1. Manufacturers:
   a. Foster Products; Vapor-Safe.
   b. Childers; Vi-Cryl.
   c. Eagle Bridges; Sure-Kote.
   d. Substitutions: See *Division 01 60 00* - Product Requirements.

K. Insulating Cement: ASTM C449.
1. Manufacturers:
   a. BNZ Materials, Inc.;
   b. Ramco; Thermokote.

c. Substitutions: See *Division 01 60 00* - Product Requirements.

2.03 EXPANDED POLYSTYRENE

A. Insulation: ASTM C578; rigid closed cell.
1. K (Ksi) Value: 0.23 at 75 degrees F (0.033 at 24 degrees C).
2. Maximum Service Temperature: 165 degrees F (74 degrees C).
3. Maximum Water Vapor Permeance: 5.0 perm inch (287 ng/(Pa s m)).

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
1. Aeroflex USA, Inc: www.aeroflexusa.com.
2. Armacell LLC: www.armacell.us.
3. K-Flex USA LLC: www.kflexusa.com.
4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
2. Maximum Service Temperature: 220 degrees F (104 degrees C).
3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
1. Manufacturers:
a. K-Flex; 120.
b. Nomaco; Flextherm.
c. Armaflex; 520.
d. Substitutions: See *Division 01 60 00* - Product Requirements

2.05 JACKETING

A. PVC Plastic.
1. Manufacturers:
a. Johns Manville Corporation: www.jm.com.
b. Substitutions: See *Division 01 60 00* - Product Requirements.
2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F (Minus 18 degrees C).
b. Maximum Service Temperature: 150 degrees F (66 degrees C).
c. Moisture Vapor Permeability: 0.020 perm inch (0.029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil, 0.010 inch (0.25 mm).
e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic: Compatible with insulation.
a. Manufacturers:
1) Knauf; Expert.
2) Johns Manville; Z-Tape.
3) Owens Corning Corp.
4) Substitutions: See *Division 01 60 00* - Product Requirements.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
1. Thickness: 0.016-inch (0.40 mm) sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2-inch (50 mm) laps.
4. Fittings: 0.016 inches (0.40 mm) thick die-shaped fitting covers with factory-attached protective liner.
5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.
B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.
D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
E. Glass fiber insulated pipes conveying fluids below ambient temperature:
    1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
    2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
F. For hot piping conveying fluids 180 degrees or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
G. Glass fiber insulated pipes conveying fluids above ambient temperature:
    1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
    2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
H. Inserts and Shields:
    1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
    2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
    3. Insert Location: Between support shield and piping and under the finish jacket.
    4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
    5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.
J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with canvas jacket sized for finish painting.
K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
L. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil, 0.001 inch (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
M. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
N. Fiber Glass For Hot Piping:
    1. Apply insulation to pipe with side and end joints butted tightly. Seal self-sealing jacket laps and butt joint strips with nylon sealing tool. Fittings shall be finished as specified under "COLD PIPING." Cover fitting with preformed PVC covering.
O. Armaflex Pipe Insulation
    1. Apply in accordance with latest edition of Armstrong's "INSTALLATION INSTRUCTIONS TO THE Contractor." Apply two coats of Armstrong's WB Vinyl Finish with color selected by Engineer.
P. Pipe Insulation Exposed To Weather
    1. Provide aluminum jacket 0.016" thick and smooth. Provide side and end laps of 2" minimum with cut edge of side lap turned under 1" for smooth edge. Seal laps with weatherproof sealant. Position laps to shed water. Secure jacket in place with bands 1/2" x 0.015" thick placed on 9" centers. Extend exterior insulation and jacketing 2" beyond sleeve inside building.

Q. The application of all insulation shall be performed by experienced mechanics, regularly employed in the trade, in a neat and workmanlike manner. Unless otherwise specified to a greater quality, the application of all insulation shall be in accordance with the manufacturer's recommendations.
R. Omit insulation from the following items:
   1. Exposed plated plumbing pipe (except for ADA requirements).
   2. Pipe vents to atmosphere, discharge from safety and relief valves, overflow pipes, and hot only drain pipes.
   3. Valves, Unions, Flanges, Traps, Strainers, and devices in HOT ONLY piping.
S. Provide semi-circular protection saddles of #16-gage galvanized steel, 12" long, for insulated piping where hangers occur. On pipe sizes 2" and over, provide 12" length of foam-glass insulation at hangers.
T. Insulation facings shall be acceptable to NFPA Standards 90A and 90B and ASTM C1136.
U. All exposed ends of pipe insulation shall be pointed up neatly with appropriate insulating cement or use pre-molded PVC end caps on cold only piping and preformed aluminum end caps on hot piping.
V. Piping systems shall be tested and cleaned before insulation is applied.

3.03 SCHEDULES

A. DOMESTIC COLD WATER (ABOVE-GRADE): Owens-Corning or Knauf 1/2" thick fiber glass, one piece, pipe insulation with factory-applied White All Service (ASJ) Vapor Barrier Jacket. Fittings shall be molded or mitered fiber glass for sizes under 3" and molded fiber glass for sizes 3" and larger.
B. DOMESTIC HOT WATER (ABOVE-GRADE): Owens-Corning or Knauf 1-1/2" (for pipe less than 1-1/2" or 2" (for pipes greater than 2") thick fiber glass, one-piece, pipe insulation with factory-applied White All-Service (ASJ) Vapor Barrier Jacket. Fittings shall be OC-110 Cement for sizes under 3" and molded fiber glass for sizes 3" and larger.
C. DOMESTIC HOT WATER RETURN piping shall be the same as for domestic hot water.
D. INTERNAL STORM DRAIN RAIN LEADER PIPING (ABOVE-GRADE): Owens-Corning or Knauf 1/2" thick fiber glass, one-piece, pipe insulation with factory-applied White All-Service (ASJ) Vapor Barrier Jacket. Fittings shall be molded or mitered fiber glass.
E. AIR CONDITIONING UNIT CONDENSATE DRAINS: Armstrong's AP Armaflex Pipe Insulation ½" thick (Freezer and Refrigerator drains same as domestic cold water).

DIVISION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

PART 1 GENERAL – 100% Commissioning required.

1.1 SUMMARY

A. The work under this Section is subject to requirements of the Contract Documents including the Owner's General Conditions and articles of the Construction Manager's General Conditions.
B. General commissioning requirements are detailed in *Division 01*.
C. The commissioning process does not reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product in accordance with the Contract Documents.
D. This section shall in no way diminish the responsibility of the *Division 22* Contractors, Subs and Suppliers in performing all aspects of work and testing as outlined in the contract documents. Any requirements outlined in this section are in addition to requirements outlined in *Division 01* and *22* Specifications.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
B. The requirements in this section are in addition to those specifically outlined in:
   1. *Division 01 80 00* – Minimum Owner Training Requirements
   2. *Division 01 90 00* – General Commissioning Requirements

1.3 PLUMBING EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

A. The following equipment and systems shall be commissioned as part of this project. All general references to equipment and systems within this:
   1. Domestic Water Heaters

2. Plumbing Fixture Controls
3. Recirculation Pumps

1.4 REFERENCES

A. Refer to *Division 01 90 00* for applicable references for work associated with this section.

1.5 DEFINITIONS & ABBREVIATIONS

A. Refer to *Division 01 41 16* for definitions and abbreviations for terms in this section.

1.6 COMMISSIONING TEAM

A. Refer to *Division 01 90 00* for commissioning team members.

1.7 COMMISSIONING SUBMITTALS

A. Refer to *Division 01 90 00* for additional information regarding commissioning submittals.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. Refer to *Division 01 90 00* for additional test equipment requirements.

B. If not otherwise specified, the following minimum requirements apply.

1. Temperature sensors and digital thermometers shall have a certified accuracy of 0.5°F and a resolution of ±0.1°F.
2. Pressure sensors shall have an accuracy of ±2.0% of the value range being measured (not full range of meter).

PART 3 EXECUTION

3.1 COMMISSIONING PROCESS OVERVIEW

A. Refer to *Division 01 90 00* for an overview of the commissioning process.

3.2 ROLES AND RESPONSIBILITIES

A. Refer to *Division 01 90 00* for roles and responsibilities of additional team members.

3.3 SCHEDULING AND COORDINATION

A. Refer to *Division 01 90 00* for scheduling and coordination requirements.

3.4 PRE-FUNCTIONAL CHECKLISTS

A. Refer to *Division 01 90 00* for PFC requirements.

3.5 START-UP AND INITIAL CHECKOUT

A. Refer to *Division 01 90 00* for Start-Up and Checkout requirements.

3.6 FUNCTIONAL PERFORMANCE TESTS

A. Refer to *Division 01 90 00* for FPT requirements.

B. Execution:

1. The PC shall engage equipment manufacturer or other 3rd party to execute testing of water quality or conditioning systems (i.e. water softener, reverse osmosis, etc.).
2. FPTs for water quality or conditioning systems shall include tests/samples upstream and downstream of equipment. Samples and/or testing shall be performed to verify equipment is operating properly and delivering water that meets standards identified in the contract documents. If no specific requirements are indicated in the contract documents, industry standards for the tested system shall be utilized.
3. All costs associated with testing water quality or conditioning systems shall be included in the PC's price for the project.
4. The CxA will witness and document the testing performed by the PC or PC's consultant.
5. If the PC does not properly coordinate and schedule with the CxA as identified in *Division 01 90 00*, costs to repeat testing shall be the responsibility of the PC.
6. All costs to repeat testing due to failure shall be the responsibility of the PC.

3.7 NON-CONFORMANCE AND COMMISSIONING ISSUES

A. Refer to *Division 01 90 00* for information regarding Non-Conformance and Cx Issues.

3.8 OWNER TRAINING

A. The GC/CM is responsible for execution of Owner Training as outlined in *Division 01 80 00*.

DIVISION 22 10 05 - PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.
   1. Sanitary sewer.
   2. Chemical resistant sewer.
   3. Domestic water.
   4. Storm water.
   5. Flanges, unions, and couplings.
   6. Pipe hangers and supports.
   7. Valves.

1.02 RELATED REQUIREMENTS

A. *Division 22 05 53* - Identification for Plumbing Piping and Equipment.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturer's catalog information. Indicate valve data and ratings.
C. Sustainable Design Documentation: Submit appropriate evidence that materials used in potable water systems comply with the specified requirements.
D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
E. Sustainable Design Documentation: For soldered copper joints, submit installer's certification that the specified installation method and materials were used.
F. Project Record Documents: Record actual locations of valves.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See *Division 01 60 00* - Product Requirements for additional provisions.
   2. Valve Repacking Kits: One for each type and size of valve.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.
B. Valves: Manufacturer's name and pressure rating marked on valve body.
C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
B. Provide temporary protective coating on cast iron and steel valves.
C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.06 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight.
   1. Fittings: Cast iron.
   2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
B. Cast Iron Pipe: CISPI 301, hubless.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

2.03 SANITARY WASTE PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight.
   1. Fittings: Cast iron.
   2. Joint Seals: ASTM C564 neoprene gaskets or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.04 CHEMICAL-RESISTANT SANITARY WASTE PIPING

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

B. PP Pipe: Polypropylene, flame retardant.
   1. Fittings: Polypropylene.
   2. Joints: Electrical resistance fusion.

2.05 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Copper Pipe: ASTM B42, hard drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
   2. Joints: ASTM B32, alloy Sn95 solder.
   3. Joints: AWS A5.8M/A5.8, BCuP copper and silver braze.

B. Ductile Iron Pipe: AWWA C151/A21.51.
   1. Fittings: Ductile or gray iron, standard thickness.
   2. Joints: AWWA C111/A21.11, styrene butadiene rubber (SBR) or vulcanized SBR gasket with 3/4 inch (19 mm) diameter rods.

2.06 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Pipe: ASTM B88 (ASTM B88M), Type L (A), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints: ASTM B32, alloy Sn95 solder.

2.07 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight.
   1. Fittings: Cast iron.
   2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.08 STORM DRAINAGE PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.09 NATURAL GAS PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
   1. Fittings: ASTM A234/A234M, wrought steel welding type.
   2. Joints: ASME B31.1, welded.
   3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

2.10 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to ASME B31.1.

2.11 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 inch (80 mm, DN) and Under:
   1. Ferrous Pipe: Class 150 malleable iron threaded unions.
   2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Sizes Over 1 inch (25 mm, DN):
   1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.12 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
      a. Cold and Hot Pipe Sizes 6 inch (150 mm, DN) and Larger: Double hangers.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
   4. Vertical Pipe Support: Steel riser clamp.
   5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
   6. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
      a. Bases: High-density polypropylene.
      b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
      c. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
      d. Attachment and Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
      e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.
      f. Manufacturers:
         1) PHP Systems/Design: www.phpsd.com.
         2) Substitutions: See *Division 01 60 00* - Product Requirements.

B. Plumbing Piping - Drain, Waste, and Vent:
   1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
   2. Hangers for Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.
   3. Wall Support for Pipe Sizes to 3 inch (80 mm, DN): Cast iron hook.
   4. Wall Support for Pipe Sizes 4 inch (100 mm, DN) and Over: Welded steel bracket and wrought steel clamp.
   5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:
   1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
   2. Hangers for Cold Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.
   3. Hangers for Hot Pipe Sizes 2 to 4 inch (50 to 100 mm, DN): Carbon steel, adjustable, clevis.
   4. Hangers for Hot Pipe Sizes 6 inch (150 mm, DN) and Larger: Adjustable steel yoke, cast iron pipe roll, double hanger.
   5. Wall Support for Pipe Sizes Up to 3 inch (80 mm, DN): Cast iron hook.
   6. Wall Support for Pipe Sizes 4 inch (100 mm, DN) and Larger: Welded steel bracket and wrought steel clamp.
   7. Wall Support for Hot Pipe Sizes 6 inch (150 mm, DN) and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
   8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   9. Floor Support for Hot Pipe Sizes to 4 inch (100 mm, DN): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
   10. Floor Support for Hot Pipe Sizes 6 inch (150 mm, DN) and Larger: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.

11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Comply with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Comply with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Comply with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Comply with ICC-ES AC106.
   5. Concrete Adhesive Type Anchors: Comply with ICC-ES AC308.
   6. Other Types: As required.
   7. Manufacturers:
      a. Powers Fasteners, Inc: www.powers.com.
      b. Substitutions: See *Division 01 60 00* - Product Requirements.

2.13 BALL VALVES

A. Manufacturers:
   1. Grinnell Products, a Tyco Business: www.grinnell.com.
   2. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

2.14 BUTTERFLY VALVES

A. Manufacturers:
   1. Grinnell Products: www.grinnell.com/#sle.
   2. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Construction 1-1/2 inch (40 mm, DN) and Larger: MSS SP-67, 200 psi (1380 kPa) CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.

C. Provide gear operators for valves 8 inches (150 mm, DN) and larger, and chain-wheel operators for valves mounted over 8 feet (2400 mm) above floor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide access where valves and fittings are not exposed.

H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

I. Provide support for utility meters in accordance with requirements of utility companies.

J. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.

K. Excavate in accordance with Section 31 2316.

L. Install bell and spigot pipe with bell end upstream.

M. Install valves with stems upright or horizontal, not inverted.

N. Install water piping to ASME B31.9.

O. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

P. Sleeve pipes passing through partitions, walls, and floors.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.
B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
D. Install globe valves for throttling, bypass, or manual flow control services.
E. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
F. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/4 inch per foot (1:50) slope.
B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with state and local codes.
B. Prior to starting work, verify system is complete, flushed, and clean.
C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
D. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
F. Maintain disinfectant in system for 24 hours.
G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.07 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
    1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
    2. Provide 18 gauge, 0.0478-inch (1.21 mm) galvanized sheet metal sleeve around service main to 6 inch (150 mm) above floor and 6 feet (1800 mm) minimum below grade. Size for minimum of 2 inches (50 mm) of loose batt insulation stuffing.

3.08 SCHEDULES

A. Pipe Hanger Spacing:
    1. Metal Piping:
        a. Pipe Size: 1/2 inch (15 mm, DN) to 1-1/4 inch (32 mm, DN):
            1) Maximum Hanger Spacing: 6.5 ft (2 m).
            2) Hanger Rod Diameter: 3/8 inches (9 mm).
        b. Pipe Size: 1-1/2 inch (40 mm, DN) to 2 inch (50 mm, DN):
            1) Maximum Hanger Spacing: 10 ft (3 m).
            2) Hanger Rod Diameter: 3/8 inch (9 mm).
        c. Pipe Size: 2-1/2 inch (65 mm, DN) to 3 inch (80 mm, DN):
            1) Maximum Hanger Spacing: 10 ft (3 m).
            2) Hanger Rod Diameter: 1/2 inch (13 mm).
        d. Pipe Size: 4 inch (100 mm, DN) to 6 inch (150 mm, DN):
            1) Maximum Hanger Spacing: 10 ft (3 m).
            2) Hanger Rod Diameter: 5/8 inch (15 mm).
        e. Pipe Size: 8 inch (200 mm, DN) to 12 inch (300 mm, DN):
            1) Maximum hanger spacing: 14 ft (4.25 m).
            2) Hanger Rod Diameter: 7/8 inch (22 mm).
        f. Pipe Size: 14 inch and Over (350 mm, DN and Over):

1) Maximum Hanger Spacing: 20 ft (6 m).
2) Hanger Rod Diameter: 1 inch (25 mm).

2. Plastic Piping:
   a. All Sizes:
      1) Maximum Hanger Spacing: 6 ft (1.8 m).
      2) Hanger Rod Diameter: 3/8 inch (9 mm).

DIVISION 22 10 06 - PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Drains.
B. Cleanouts.
C. Hose bibbs.
D. Hydrants.
E. Refrigerator valve and recessed box.
F. Back water valves.
G. Backflow preventers.
H. Water hammer arrestors.
I. Catch basins and manholes.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Manhole bottoms.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
D. Certificates: Certify that grease interceptors meet or exceed specified requirements.
E. Sustainable Design Documentation: Submit appropriate evidence that materials used in potable water systems comply with the specified requirements.
F. Operation Data: Indicate frequency of treatment required for interceptors.
G. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
H. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, and water hammer arrestors.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See *Division 01 60 00* - Product Requirements for additional provisions.
   2. Extra Loose Keys for Outside Hose Bibbs: One.
   3. Extra Hose End Vacuum Breakers for Hose Bibbs: One.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
   2. Josam Company: www.josam.com.
   3. Zurn Industries, Inc: www.zurn.com.
B. Roof Drains:
   1. Assembly: ASME A112.6.4.
   2. Body: Lacquered cast iron with sump.
   3. Strainer: Removable polyethylene dome with vandal proof screws.
   4. Accessories: Coordinate with roofing type:
      a. Membrane flange and membrane clamp with integral gravel stop.

b. Adjustable under deck clamp.
c. Roof sump receiver.
d. Waterproofing flange.
e. Controlled flow weir.
f. Leveling frame.
g. Adjustable extension sleeve for roof insulation.
h. Perforated or slotted ballast guard extension for inverted roof.
i. Perforated stainless steel ballast guard extension.

C. Canopy and Cornice Drains:
1. Lacquered cast iron body with aluminum flashing clamp collar and epoxy coated flat strainer.

D. Roof Overflow Drains:
1. Lacquered cast iron body and clamp collar and bottom clamp ring; pipe extended to 2 inches above flood elevation.

E. Downspout Nozzles:
1. Bronze round with straight bottom section.

F. Area Drains:
1. Assembly: ASME A112.6.4.
2. Body: Lacquered cast iron with sump.
3. Strainer: Round nickel-bronze.
4. Accessories: Membrane flange and membrane clamp with integral gravel stop, with adjustable under deck clamp.

G. Floor Drains:
1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

2.03 CLEANOUTS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Josam Company: www.josam.com.
3. Zurn Industries, LLC: www.zurn.com.

B. Cleanouts at Exterior Surfaced Areas:
1. Round cast nickel bronze access frame and non-skid cover.

C. Cleanouts at Interior Finished Floor Areas:
1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

D. Cleanouts at Interior Finished Wall Areas:
1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

E. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.04 HOSE BIBBS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Watts Regulator Company: www.wattsregulator.com.
3. Zurn Industries, Inc: www.zurn.com.

B. Interior Hose Bibbs:
1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome-plated where exposed with handwheel, integral vacuum breaker in compliance with ASSE 1011.

C. Interior Mixing Type Hose Bibbs:
1. Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome-plated where exposed with handwheels, and vacuum breaker in compliance with ASSE 1011.

2.05 HYDRANTS

A. Manufacturers:
   1. Arrowhead Brass Company: www.arrowheadbrass.com.
   2. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
   3. Zurn Industries, Inc: www.zurn.com.
B. Wall Hydrants:
   1. ASSE 1019; freeze resistant, self-draining type with chrome-plated wall plate hose thread spout, handwheel, and integral vacuum breaker.

2.06 REFRIGERATOR VALVE AND RECESSED BOX

A. Box Manufacturers:
   1. IPS Corporation/Water-Tite: www.ipscorp.com.
   2. Oatey: www.oatey.com.
B. Valve Manufacturers:
   1. IPS Corporation/Water-Tite: www.ipscorp.com.
   2. Zurn Industries, Inc: www.zurn.com.
C. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

2.07 BACK WATER VALVES

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
   2. Savko Plastic Pipe & Fittings, Inc: www.savko.com.
   3. Zurn Industries, Inc: www.zurn.com.
B. Cast Iron Back Water Valves: ASME A112.6.4; lacquered cast iron body and cover, brass valve, extension sleeve, and access cover.
C. Plastic Backwater Valves: ABS body and valve, extension sleeve, and access cover.

2.08 BACKFLOW PREVENTERS

A. Manufacturers:
   1. Conbraco Industries: www.apollovalves.com.
   2. Watts Regulator Company: www.wattsregulator.com.
   3. Zurn Industries, Inc: www.zurn.com.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Reduced Pressure Backflow Preventer Assembly:
   1. ASSE 1013; cast bronze body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, and non-threaded vent outlet.

2.09 WATER HAMMER ARRESTORS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
   2. Watts Regulator Company: www.wattsregulator.com.
   3. Zurn Industries, Inc: www.zurn.com.
B. Water Hammer Arrestors:
   1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F (minus 73 to 149 degrees C) and maximum 250 psi (1700 kPa) working pressure.

2.10 CATCH BASINS AND MANHOLES

A. Manufacturers:
   1. Hanson Pipe & Precast: www.hansonpipeandprecast.com.
   2. Kistner Concrete Products, Inc: www.kistner.com.
   3. Sherman Dixie Concrete Industries: www.shermandixie.com.
B. Catch Basins:
   1. Barrel: ASTM C478/C478M; precast concrete sections laid on cast-in-place reinforced concrete foundation pad, 36 inches (900 mm) or 48 inches (1200 mm) diameter with precast concrete top.
   2. Inlet Assembly: Two-piece heavy duty cast steel or cast-iron frame and grate with ground or machined grate and frame bearing surfaces.

3. Slope bottom slab 10 percent to outlet invert.
4. Provide minimum 2 feet (600 mm) sump below outlet.

C. Manholes: Formed-bottom type, laid on cast-in-place reinforced concrete foundation pad, see Section 03 3000.
1. Construction: Concrete masonry units.
2. Size: 48-inch (1200 mm) diameter.
3. Cover: Standard cast iron with minimum sized pick hole, and frame. Use heavy duty cover and frame in vehicular traffic areas.
a. Manufacturers:
1) Campbell Group: www.campbellfoundry.com.
2) Neenah Foundry Company: www.nfco.com.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
C. Encase exterior cleanouts in concrete flush with grade.
D. Install floor cleanouts at elevation to accommodate finished floor.
E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
F. Pipe relief from backflow preventer to nearest drain.
G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks or washing machine outlets.
H. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch (20 mm) minimum, and minimum 18 inches (450 mm) long.

DIVISION 22 11 16 - DOMESTIC WATER PIPING

GENERAL

This includes domestic hot water and cold water piping within the building to a point 5' outside building.
UNDERGROUND PIPING: Type "K" copper with silver soldered joints. Do not locate joints below ground.
ABOVE GROUND PIPING: Type "L" copper with silver soldered joints for 1 1/4" and smaller, silver solder for 1 1/2" and larger.

*QUICK CONNECT FITTINGS SHALL NOT BE USED.****PRO-PRESS OR PEX PIPING IS NOT ACCEPTED AND WILL NOT BE APPROVED.***

BACKFLOW PREVENTER: Provide reduced pressure principle assembly with strainer. Provide redundant assembly (i.e. two 4” BFPs where a 4” line is serving the building). The building design should dictate where the BFP is located, either in a hot box or pit along the service entrance, or in the building. If located within the building, locate between 12" and 60" above finish floor. Pipe discharge to floor drains.

Install a hot and a cold water cut-off in the Corridor ceiling for each supply for a safety/maintenance cut-off.

PRESSURE REGULATING VALVE: Provide for all installations. Include strainer, bypass, and pressure gauge.

POLYPROPYLENE PIPING SYSTEMS (PP-R): Designer shall consider the use of a PP-R system in relation to project schedule and budget. PP-R system installation shall be heat-infused only. Basis of design shall use Aquatherm blue piping for heating/ cooling and green piping for domestic water and sprinkler piping. Design shall include training and certification for MSCS maintenance as well as equipment for maintenance for PP-R piping.

DESIGNER SHALL PROVIDE IN PROJECT MANUAL AND ON CONSTRUCTION DOCUMENTS THAT THE PP-R INSTALLER(S) ARE CERTIFIED BY THE MANUFACTURER OF THE PRODUCT THEY ARE INSTALLING AND HAVE A MINIMUM WORK EXPERIENCE WITH THE PRODUCT OF NO LESS THAN FIVE (5) YEARS. PROJECT MANUAL SHALL INCLUDE TRAINING AND CERTIFICATION OF MSCS MAINTENANCE PERSONNEL.

DIVISION 22 13 00 - KITCHEN PLUMBING

GENERAL

Use stainless steel 12" x 12" x 10" ZURN Z-1752-KC-Y-2 or equal floor sink for indirect waste from prep and pot sinks & steamer. PVC or porcelain floor sinks are not acceptable.

Use 7" round recessed strainer floor drain for indirect waste from ice machine, serving line equipment, and cooler/freezer.

Use stainless steel floor troughs for waste from tilting skillet, and area in front of steam kettle (if specified).
Use stainless steel strainers built-in as a component of the trough.

Provide wrist blade handles at hand sinks. Supply 120° F water to hand sinks.
Add adequate quantity of general area floor drains to kitchen so entire floor can be hosed down.
Use utility raceway to serve equipment under hood. Use flexible hoses to serve equipment.
Length of hoses shall be adjusted or shortened to prevent hoses from lying on the floor.

Kitchen equipment will use natural gas where available. Do not use LP gas.

Hood manufacture will furnish solenoid gas shut off valve to Plumbing Contractor for installation.
Supply 140°F. water to dishwasher, prep and pot skins, can wash and mop receptor.
Use of supplemental heater may be acceptable in some kitchen configurations.
Circulate hot water for 140° and 120° loops.

Use American Standard freeze-proof mixing faucet for can wash. Use non-clog floor drain for can wash.
Use recoiling manual hose reel in dishwashing area and 3-compartment sink area for wash down.
Do not connect disposals to grease interceptor.
Use manual hose reel in Serving Area for water fill and wash down.
Use copper pipe for prep and pot sink continuous waste.
Use trap primers for all floor drains.
Use shock absorbers for all solenoid operated equipment. Provide water filter at kitchen icemaker connection.

Design grease trap in accordance with Shelby County Health Department requirements.

DIVISION 22 13 16 - DRAINAGE AND VENT SYSTEMS

GENERAL

Includes sanitary, acid and storm drainage and vent piping systems inside building to a point 5' outside building. Roof drains are furnished and installed by General Contractor. Plumbing Contractor connects line to roof drain outlet.

CLEANOUTS AT FINISH GRADE: Cast brass plug with recessed slot in fitting or in caulked cast iron ferrule. Set in center of 24" x 24" x 8" thick concrete pad flush with grade.
PIPE SLEEVES: Schedule 40 black steel.

VENTS THROUGH ROOF: 10' minimum from fresh air intake. Extend vent 2’-0” above finished roof.
MSCS recommends minimizing roof penetrations and request wall penetrations when applicable.
Depress floor drains below room perimeter minimum of 1/2".

Provide acid neutralizing sump for darkroom waste, high school chemistry and middle school IPS science room waste.

DIVISION 22 30 00 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged water heating systems.
B. Diaphragm-type compression tanks.
C. Acid neutralizers.
D. In-line circulator pumps.
E. Pressure booster systems.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. CSA C22.2 No. 218.1 - Spas, Hot Tubs, and Associated Equipment; 2013 (Reaffirmed 2022).
B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
C. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.
D. UL 1081 - Swimming Pool Pumps, Filters, and Chlorinators; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittals procedures.
B. Product Data:
   1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
   2. Indicate pump type, capacity, power requirements.
   3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
C. Shop Drawings:
   1. Indicate heat exchanger dimensions, size of tappings, and performance data.
   2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Pump Seals: One of each type and size.
   3. Extra Water Softener Salt: 50 pounds (22.7 kg).
G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.06 CLOSEOUT SUBMITTALS

A. See *Division 01* Section “Closeout Submittals.”
B. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.07 QUALITY ASSURANCE

A. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
B. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.
C. Perform Work in accordance with all State and local code standards.
D. Maintain one copy of each document on site.

1.08 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years’ experience.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

B. Accept water heaters on site in original labeled cartons. Inspect for damage.
C. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.10 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals, for additional warranty and bond requirements.
B. Provide five-year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 PACKAGED WATER HEATING SYSTEMS

A. Manufacturers:
   1. Lochinvar Corporation: www.lochinvar.com.
   2. Tigerflow: www.tigerflow.com.
   3. Substitutions: See *Division 01 60 00* - Product Requirements.
B. System: Gas-fired direct heating boiler, circulating pump, controls, piping and valving as indicated, storage tank, all mounted on structural steel skid.
C. Boiler:
   1. Type: Gas-fired water tube boiler, with copper finned tube heat exchanger, steel jacket with glass fiber insulation.
   2. Boiler Trim: Gas burner, thermometer and pressure gauge, immersion thermostats for operating and high limit protection, 100 percent safety shut-off electric gas valve with transformer, electronic safety pilot and pilot burner, gas pressure regulator, manual gas shut-off, low water cut off, ASME rated temperature and pressure relief valve, coil relief valve, automatic boiler fill and expansion tank, draft inverter.
   3. Performance:
      a. Annual Fuel Utilization Efficiency: 0.80.
D. Vertical storage tank:
   1. Working Pressure: 150 psi (1000 kPa) ASME labeled.
   2. Lining: 15 mils (0.38 mm) thick epoxy lining extended through flanges and couplings.
   3. Support: Two welded tank saddles not less than 4 inches (100 mm) wide by 1/4-inch (6 mm) thick, mounted on 2-inch (50 mm) pipe stand with minimum four cross braced legs; sheet teflon isolation strip between tank and saddle; dielectric unions between tank and piping system.
   4. Insulation: 3-inch (75 mm) glass fiber insulation with steel jacket.
E. Pump:
   1. Type: All bronze, in-line circulation pump mounted on boiler, controlled by tank mounted immersion thermostat.
   2. Thermostat Setpoint: 140 degrees F (60 degrees C).
F. Thermostatic Valve: Three-way, self-contained, full line size, bronze body 1/2 to 2 inches (13 to 50 mm) size, iron body 2-1/2 inches (60 mm) and over, set at 140 degrees F (60 degrees C).

2.02 ACID NEUTRALIZERS

A. Manufacturers:
   1. Aquapure, 3M Purification, Inc: www.aquapure.com.
   2. Substitutions: See *Division 01 60 00* - Product Requirements.

2.03 IN-LINE CIRCULATOR PUMPS

A. Manufacturers:
   1. Armstrong Pumps Inc: www.armstrongpumps.com.
   2. ITT Bell & Gossett: www.bellgossett.com.
   3. SIHI Group: www.sterlingsihi.com.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Casing: Bronze, rated for 125 psig (860 kPa) working pressure, with stainless steel rotor assembly.
C. Impeller: Bronze.
D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
E. Seal: Carbon rotating against a stationary ceramic seat.
F. Drive: Flexible coupling.

2.04 PRESSURE BOOSTER SYSTEMS

A. Manufacturers:
   1. Armstrong Pumps Inc: www.armstrongpumps.com.

2. ITT Bell & Gossett: www.bellgossett.com.
3. Syncro Flo, Inc: www.syncroflo.com/#sle.
4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. System: Packaged with two pumps, factory assembled, tested, and adjusted; shipped to site as integral unit; consisting of pumps, valves, and galvanized piping, with control panel assembled on fabricated steel base with structural steel framework.

C. Controls and Instruments: Locate in NEMA 250 Type 1 general purpose enclosure with main disconnect interlocked with door, fused circuit for each motor, magnetic starters with three overloads, control circuit transformer with fuse protection, selector switch for each pump, low limit pressure switch, low pressure alarm light, running lights, current sensing devices, minimum run timers, manual alternation, and suction and discharge pressure gauges.

D. Lead Pump: Operate continuously with lag pump operating on system demand. Should lead pump fail to operate, next pump in sequence shall start automatically.

E. Time Delay Relay: Prevent lag pump short cycling on fluctuating demands.

F. Thermal Bleed Circuit with Solenoid Valve: Prevent overheating during low demand.

G. Low Pressure Control: Stop pump operation if incoming water pressure drops to atmospheric.

H. Pump Switch: Permit manual or automatic operation.

I. Valving: Each pump outlet combination pressure reducing and check valve to maintain constant system pressure. Provide gate or butterfly valves on suction and discharge of each pump. Provide check valve on each pump discharge.

J. Time Clock for Automatic Day-Night Changeover:
1. Day cycle: System shall operate continuously with pressure to fixtures maintained by pressure reducing valves.
2. Night Cycle: Pump shall operate intermittently on pressure switch located near pressure tank operating pump for pre-determined adjustable time period.

2.05 SUMP PUMPS

A. Manufacturers:
1. Armstrong Pumps Inc: www.armstrongpumps.com.
2. Goulds Pumps: www.goulds.com.
3. Zoeller Pump Company: www.zoeller.com.
4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Type: Vertical centrifugal, direct connected, simplex arrangement.

C. Casing: Cast iron volute with radial clearance around impeller, inlet strainer, slide away couplings.

D. Impeller: Cast iron; open non-clog, keyed to corrosion resistant alloy steel shaft.

E. Support: Cast iron pedestal motor support on steel floor plate with gas tight gaskets.

F. Bearings: Forced grease lubricated bronze sleeve spaced maximum 48 inches (1200 mm) and grease lubricated ball thrust at floor plate.

G. Drive: Flexible coupling to vertical, solid shaft ball bearing electric motor.

H. Sump: Steel cover plate with steel curb frame for grouting into concrete sump with inspection opening and cover, and alarm fittings.

I. Controls (Simplex): Float switch with float rod, stops, and corrosion resistant float, and separate pressure switch high level alarm with transformer, alarm bell and standpipe.

J. Controls (Duplex): Float operated mechanical alternator with float rod, stops, and corrosion resistant float to alternate operation of pumps, cut-in second pump on rising level or lead pump failure, separate pressure switch high level alarm with transformer, alarm bell, and standpipe and emergency float switch with float rod, stops, and corrosion resistant float to operate both pumps on failure of alternator.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and comply with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

C. Domestic Water Heat Exchangers:
1. Install domestic water heat exchangers with clearance for tube bundle removal without disturbing other installed equipment or piping.

2. Support unit on pipe stand.
3. Pipe relief valves and drains to nearest floor drain.
4. Connect steam branch line from top of main. Pipe in flexible manner, pitched with steam flow, with pipe union connections. Provide steam pressure gauge at exchanger inlet.
5. Provide steam traps and valves as indicated.
6. Pitch shell for condensate drain to traps.

D. Domestic Water Storage Tanks:
1. Provide steel pipe support, independent of building structural framing members.
2. Clean and flush prior to delivery to site. Seal until pipe connections are made.

E. Pumps:
1. Ensure shaft length allows sump pumps to be located minimum 24 inches (600 mm) below lowest invert into sump pit and minimum 6 inches (150 mm) clearance from bottom of sump pit.
2. Provide air cock and drain connection on horizontal pump casings.
3. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
4. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches (100 mm) and over.
5. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
6. Align and verify alignment of base mounted pumps prior to start-up
7. Provide electrical interlocking from cooling condensate pump safety switch to associated HVAC unit(s) furnished under other Sections.

F. Maintain manufacturers recommended clearances around and over water heaters.
G. Install water heater on concrete housekeeping pad, minimum 3-1/2 inches high and 6 inches larger than water heater base on each side. Refer to Division 03.
H. Install water heater trim and accessories furnished loose for field mounting.
I. Install electrical devices furnished loose for field mounting.
J. Install control wiring between water heater control panel and field mounted control devices.
K. Furnish factory or manufacturer's service representative to verify system installation and operation.
L. Verify location and clearance requirements.
M. Install in accordance with manufacturer's recommendations and Contract Drawings.
N. Install vent line to atmosphere.
O. Insulation for water connections as specified in *Division 22 07 19*.
P. Install electric connections under *Division 26*.
Q. Clean and test unit.

DIVISION 22 42 00 - PLUMBING FIXTURES

PART 1 GENERAL

MSCS recommends that an accessible plumbing chase be provided between group restrooms for ease of maintenance and repair. Access shall be through a secured access panel or secured janitor's closet for security purposes.

Specify all vandal-proof options for all fixtures used by students. This includes handle screws, aerators and showerheads.

Manufacturers to consider for basis of design are American Standard, Eljer or Kohler. An approved equal will be accepted. All fixtures shall be white. All fixtures shall be standard height and meet ADA criteria when required. No child height fixtures shall be installed unless mandated or required by any agency outside of MSCS. Elkay and Just are acceptable manufacturers for the basis of design for stainless steel sinks.

Specify carriers for all wall hung fixtures including drinking fountains, urinals and lavatories. Toilets to be floor set unless requested otherwise.

Specify chrome plated rigid supplies with angle I.P.S. loose key stops for all Group toilet lavatories. Wheel handle stops may be used for K-2 School and all administration areas.

Specify chrome plated cast brass p-trap, basket strainers, grid strainers and pop-up assemblies and all tubular slip-joint piping as well as wall nipple for all lavatories, sinks and shampoo bowls.

Hair interceptors for all shampoo bowls shall be ZURN Z1175 or equivalent, made of dura-coated cast iron hair and solids interceptor, in lieu of fixture “P”-trap, with 1-1/2” slip joint elbow inlet and 1-1/2 threaded side outlet, perforated stainless steel basket removable from bottom, with flanged and gasketed cleanout cover with raised hex head. Perforation size is 1/8”.

Lavatories outside of the Group Restrooms are to be Bradley Verge LVRD Series with Moen Model 8886 metering faucets. Hard wired hands-free sensor faucets shall be considered on a case-by-case basis.

Specify chrome plated semi-cast 17 gaged brass p-traps for all sinks and water coolers. Specify separate stops for all fixtures unless integral stops.

Sloan or Delany are acceptable basis of design manufacturers of flush valves with solid ring supports. As an alternative, the TOTO EcoPower flush valve, hydropower self-generating system or equivalent can be used.

Metered faucets shall be provided at all lavatories. (Moen M8886 two-handle ADA metering lavatory faucet)

Automatic faucets shall only be used at student sinks in pre-K rooms. (Moen M8554 .5 GPM sensor faucet)

Hardwired hands-free sensor faucets will be considered on a case-by-case basis.

Specify chase for multiple lavatory installations (minimum 6" clear).

Specify chase for group toilets (walk-in chase is preferred but not required with 24” minimum width).

Connect circulating pumps to Energy Management system.

Specify separate flue for water heaters.

Use energy efficient gas water heaters for kitchens and gym areas.
High-performance water heaters shall be considered on a case-by-case basis.

Dimension floor drain locations on drawings.

Specify washer box for all residential type washing machines with cold water, hot water and drain.

Specify vitreous China wall hung lavatories, 4" centers, 20" x 18" with grid drain.

Specify center-set lavatory fitting for student Group toilets. Use single-hole faucets for lavatories.

Specify single bowl sinks for K-4 classrooms and workrooms. Verify they are ADA compliant installations.

Hose Bibbs in group toilets are to be recessed Woodford model 75 wall hydrant SWVL INL.
An approved equal will be considered.

Specify pre-cast mop receptor with stainless steel wall protector. Custodial sinks should be deep and steel-edged to prevent chipping. Coordinate with the Owner.

Specify cold water for all refrigerator icemakers.

Specify floor mounted elongated bowl, siphon jet water closets. Specify 1.6 gallon/flush type.

Specify institutional grade water closet seats with self-sustaining check hinge.

Specify flush valve for all water closets with handle 39" above finish floor.

Coordinate water closet flush valve height with grab bars.

Specify wall mounted ADA compliant, electric water cooler, with metal bubbler spout, by Halsey Taylor or approved equal. Units with remote chillers or in-the-wall chillers are not acceptable.

Provide one bottle filler unit with filter at each electric water cooler location.

Specify ASME expansion tanks for water heaters larger than 80 gallons.

Do not connect gas water heaters to DDC system due to thermal shock of tank.

1.01 SECTION INCLUDES

A. Water closets.
B. Urinals.
C. Lavatories.
D. Sinks.
E. Service sinks.
F. Electric water coolers.
G. Drinking fountains.
H. Eye and face wash fountains.
I. Emergency showers.

1.02 RELATED REQUIREMENTS

A. *Division 07 90 05* - Joint Sealers: Seal fixtures to walls and floors.

1.03 RELATED DOCUMENTS

A. *Division 23* Section “General Provisions - Mechanical” shall also apply to this Section.
B. This Contractor shall examine all other divisions of the specifications and all drawings for the project and shall familiarize himself with all features of the project that may affect his work.
C. See other Sections for basic pipe and pipe fitting requirements, valves, pipe specialties, seismic restraint, etc.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
C. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Extra Faucet Washers: One set of each type and size.
    3. Extra Lavatory Supply Fittings: One set of each type and size.
    4. Extra Shower Heads: One of each type and size.
    5. Extra Toilet Seats: One of each type and size.
    6. Flush Valve Service Kits: One for each type and size.
F. All items furnished under this section shall be submitted for approval.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
B. All fixtures shall be roughed-in in accordance with applicable codes and per manufacturer’s instructions. All fixtures shall have stops on water supply connections.
C. No ferrous piping will be allowed in fixture supply connections.
D. Fixtures shall be installed as recommended by manufacturers and as indicated on the drawings.
E. All faucets shall be equipped with a laminar flow control device with pressure compensation from

40-120 psig.

F. Faucets and all other components of the domestic water system shall be National Sanitation Foundation (NSF) 61 compliant.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.07 WARRANTY

A. See *Division 01 78 00* - Closeout Submittals, for additional warranty requirements.

B. Provide five-year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

B. Water Efficiency: EPA WaterSense label is required for all water closets, urinals, lavatory faucets, and showerheads.

2.02 FLUSH VALVE WATER CLOSETS

A. Water Closets: Vitreous China, ASME A112.19.2, floor mounted, siphon jet flush action, China bolt caps.

1. Bowl: ASME A112.19.2; 16.5 inches (420 mm) high with elongated rim.
2. Flush Valve: Exposed (top spud).
3. Flush Operation: Sensor operated.
4. Handle Height: or less.
5. Supply Size: 1 inch.
6. Color: White.
7. Manufacturers:
   a. American Standard, Inc: www.americanstandard-us.com.
   b. Gerber Plumbing Fixtures LLC: www.gerberonline.com/#sle.
   c. Kohler Company: www.kohler.com.
   d. Zurn Industries, Inc: www.zurn.com.
   e. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.

1. Sensor-Operated Type: Solenoid or motor-driven operator, low voltage hard-wired, infrared sensor with mechanical over-ride or over-ride push button.
2. Concealed Type: Rough brass, exposed parts chrome plated, wall escutcheon, wheel handle stop.
3. Exposed Type: Chrome plated, escutcheon, integral screwdriver stops.
4. Metering Type: Easily accessible adjustment nut.
5. Manufacturers:
   a. American Standard, Inc: www.americanstandard-us.com.
   b. Delany Products: www.delanyvalve.com.
   c. Sloan Valve Company: www.sloanvalve.com.
   d. Zurn Industries, Inc: www.zurn.com.
   e. Substitutions: See *Division 01 60 00* - Product Requirements.

C. Seats:

1. Manufacturers:
   a. American Standard, Inc: www.americanstandard-us.com.
   b. Bemis Manufacturing Company: www.bemismfg.com.
   c. Church Seat Company: www.churchseats.com.
   d. Olsonite: www.olsonite.com.
   e. Zurn Industries, Inc: www.zurn.com.
   f. Substitutions: See *Division 01 60 00* - Product Requirements.
2. Solid black plastic, open front, extended back, self-sustaining hinge, brass bolts, with cover.

2.03 WALL HUNG URINALS

A. Wall Hung Urinal Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com.
   2. Kohler Company: www.kohler.com.
   3. Zurn Industries, Inc: www.zurn.com.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Urinals: Vitreous China, ASME A112.19.2, wall hung with side shields and concealed carrier.
   1. Flush Volume: 1.0 gallons (3.7 liters), maximum.
   2. Flush Style: Washout.
   3. Flush Valve: Exposed (top spud).
   4. Flush Operation: Sensor operated.
   5. Trap: Integral.
   6. Removable stainless steel strainer.
   7. Supply Size: 3/4 inch (19 mm).
   8. Outlet Size: 2 inches (50 mm).

C. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
   1. Sensor-Operated Type: Solenoid or motor-driven operator, low voltage hard-wired, infrared sensor with mechanical over-ride or over-ride push button.
   2. Concealed Type: Rough brass, exposed parts chrome plated, wall escutcheon, wheel handle stop.
   3. Exposed Type: Chrome plated, escutcheon, integral screwdriver stops.
   4. Metering Type: Easily accessible adjustment nut.
   5. Manufacturers:
      a. American Standard, Inc: www.americanstandard-us.com.
      b. Delany Products: www.delaneyvalve.com.
      c. Sloan Valve Company: www.sloanvalve.com.
      d. Zurn Industries, Inc: www.zurn.com.
      e. Substitutions: See *Division 01 60 00* - Product Requirements.

D. Carriers:
   1. Manufacturers:
      a. JOSAM Company: www.josam.com.
      b. Zurn Industries, Inc: www.zurn.com.
      c. Wade.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.04 LAVATORIES

A. Lavatory Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com.
   2. Kohler Company: www.kohler.com.
   3. Zurn Industries, Inc: www.zurn.com.
   4. Crane.
   5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Vitreous China Countertop Basin: ASME A112.19.2; vitreous China self-rimming countertop lavatory, with drillings on 4-inch (100 mm) centers, front overflow, soap depression, seal of putty, calking, or concealed vinyl gasket.

C. Vitreous China Under-Mount Basin: ASME A112.19.2; vitreous China under-mount lavatory, front overflow, mounting kit and template by manufacturer.
   1. Bowl size: 17 by 19 inch

D. Supply Faucet Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com.
   2. Kohler Company: www.kohler.com.
   3. Zurn Industries, Inc: www.zurn.com.
   4. Delta.
   5. Substitutions: See *Division 01 60 00* - Product Requirements.

E. Supply Faucet: ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum flow of 2.2 gallons per minute (8.3 liters per minute), indexed handles.
F. Sensor Operated Faucet: Cast brass, chrome plated, deck mounted with sensor located on neck of spout.
1. Spout Style: Standard.
2. Power Supply: Direct Current low voltage. Provide AC – DC transformer.
3. Mixing Valve: None, single line for tempered water.
4. Water Supply: 3/8-inch (9 mm) compression connections.
5. Aerator: Vandal resistant, 0.5 GPM (1.89 LPM), laminar flow device.
6. Automatic Shut-off: 30 seconds.
7. Sensor range: Factory set at a minimum of 3 inches (76 mm) adjustable up to 24 inches (610 mm).
8. Sensor range: Automatically adjusts.
a. Accessory: Optional remote re-programmer module to adjust pre-set factory functions.
9. Finish: Polished chrome.
10. Sensor Operated Faucet Manufacturers:
a. American Standard, Inc: www.americanstandard-us.com.
b. Gerber Plumbing Fixtures LLC: www.gerberonline.com.
c. The Chicago Faucet Company: www.chicagofaucets.com.
d. Moen Incorporated: www.moen.com.
e. Sloan Valve Company: www.sloanvalve.com.
f. Toto USA: www.totousa.com.
g. Zurn Industries, Inc; AquaSense Z6913: www.zurn.com/#sle.
h. Delta.
i. Substitutions: See *Division 01 60 00* - Product Requirements.
G. Accessories:
1. Chrome plated 17-gauge, 0.0538-inch (1.37 mm) brass P-trap with clean-out plug and arm with escutcheon.
2. Offset waste with perforated open strainer.
3. Wheel handle stops.
4. Rigid supplies.
5. Carrier:
a. Manufacturers:
1) JOSAM Company: www.josam.com.
2) Zurn Industries, Inc: www.zurn.com.
3) Wade.
4) Substitutions: See *Division 01 60 00* - Product Requirements.
b. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.

2.05 SINKS

A. Sink Manufacturers:
1. American Standard, Inc: www.americanstandard-us.com.
2. Kohler Company: www.kohler.com.
3. Elkay.
4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Single Compartment Bowl: 1; 19 by 19 by 19 inch outside dimensions 20 gage, 0.0359 inch (0.91 mm) thick, Type 302 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
1. Drain: 1-1/2 inch (38 mm) chromed brass drain.
2. Drain: 3-1/2 inch (90 mm) crumb cup and tailpiece.
C. Double Compartment Bowl: 1 33 by 33 by 33 inch outside dimensions 20 gage, 0.0359 inch (0.91 mm) thick, Type 302 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
1. Drain: 1-1/2 inch (38 mm) chromed brass drain.
2. Drain: 3-1/2 inch (90 mm) crumb cup and tailpiece.

2.06 SHOWERS

A. Bath and Shower Trim: ASME A112.18.1; concealed shower and over rim supply with diverter spout, pressure balanced mixing valve, bent shower arm with adjustable spray ball joint showerhead with maximum 2.5 gallons per minute (9.5 liters per minute) flow and escutcheon, lever operated pop-up waste and overflow.

2.07 DRINKING FOUNTAINS

A. Drinking Fountain Manufacturers:
   1. Elkay Manufacturing Company: www.elkay.com.
   2. Halsey Taylor: www.halseytaylor.com.
   3. Haws Corporation: www.hawsco.com.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.

2.08 ELECTRIC WATER COOLERS

A. Electric Water Cooler Manufacturers:
   1. Elkay Manufacturing Company: www.elkay.com.
   2. Haws Corporation: www.hawsco.com.
   3. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Water Cooler: Electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air-cooled condenser and stainless steel grille.
   1. Capacity: 8 gallons per hour (30.3 liters per hour) of 50 degrees F (10 degrees C) water with inlet at 80 degrees F (27 degrees C) and room temperature of 90 degrees F (32 degrees C), when tested in accordance with ASHRAE Std 18.
   2. Electrical: 115 V, 60 Hertz compressor, 6 foot (2 m) cord and plug for connection to electric wiring system including grounding connector.

2.09 SERVICE SINKS

A. Service Sink Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com.
   2. Commercial Enameling Company: www.cecosinks.com.
   3. Elkay Manufacturing Company: www.elkay.com.
   4. Just Manufacturing Company: www.justmfg.com.
   5. Zurn Industries, Inc: www.zurn.com.
   6. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Bowl: ASME A112.19.1; 22 by 18 by 12-inch (560 by 460 by 300 mm) deep, porcelain enameled (inside only) cast iron roll-rim sink, with 12 inch (300 mm) high back, concealed hanger, chrome plated strainer, stainless steel rim guard, cast iron P-trap with adjustable floor flange.

C. Bowl: 36 by 24 by 10 inch (900 by 600 by 250 mm) high white molded stone, floor mounted, with one inch (25 mm) wide shoulders, vinyl bumper guard, stainless steel strainer.

D. Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges.

E. Accessories:
   1. 5 feet (1.5 m) of 1/2-inch (13 mm) diameter plain end reinforced plastic hose.
   2. Hose clamp hanger.
   3. Mop hanger.

2.10 EMERGENCY EYE AND FACE WASH

A. Emergency Wash Manufacturers:
   1. Haws Corporation: www.hawsco.com.
   2. Therm-Omega-Tech, Inc: www.thermomegatech.com.
   3. Acorn.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Emergency Wash: ANSI Z358.1; wall-mounted, self-cleaning, non-clogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor, twin eye wash heads and face spray ring, stainless steel dust cover, copper alloy control valve and fittings.

2.11 EMERGENCY SHOWERS

A. Emergency Shower Manufacturers:

1. Haws Corporation: www.hawsco.com.
2. Therm-Omega-Tech, Inc: www.thermomegatech.com.
3. Acorn.
4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Emergency Shower: ANSI Z358.1; wall-mounted, self-cleaning, non-clogging 8-inch (200 mm) diameter stainless steel deluge shower head with elbow, one inch (25 mm) full flow valve with pull chain and 8-inch (200 mm) diameter ring, one inch (25 mm) interconnecting fittings.

2.12 FIXTURES

A. Fixtures shall be nonabsorbent throughout and free from waves, kiln marks or discoloration.
B. All surfaces coming in contact with walls, floors or other flat surfaces shall be flat.
C. All enameled iron ware shall be acid-resisting.
D. All fixtures shall be punched for trim specified.
E. Fixtures shall be equal to those scheduled on the drawings.

2.13 TRIM

A. All exposed finished metal parts shall be chromium-plated; except, rough-bodied parts shall be nickel-plated.
1. All supplies shall be IPS brass; except where otherwise specified.

B. All fixtures will be provided with some form of supply stop.
C. Traps for lavatories and sinks shall be chrome-plated cast brass P-traps with clean-out.
D. Provide cast brass, chrome-plated, set screw type, escutcheons on supply and waste piping.

2.14 SUPPORTS

A. Chair carriers where specified shall be approved models of Wade or equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
B. Verify that electric power is available and of the correct characteristics.
C. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories and sinks.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.
B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
C. Install components level and plumb.
D. Install and secure fixtures in place with wall supports and bolts.
E. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 9005, color to match fixture.
F. All wall-hung plumbing fixtures with lip extending more than 15" from wall shall be supported on chair carriers.
G. Unless specifically specified to be furnished with chair carrier, wall-hung lavatories, sinks, etc. shall be secured to wall with back-up plate and threaded rods. This Contractor shall furnish and install all backing, blocking, reinforcing, hangers, bolts, anchors and brackets required.
H. Fixtures mounted on uneven surfaces shall be bedded in an approved manner.
I. All hot and cold-water supplies to plumbing fixtures or to showerheads shall have a drop-ear fitting secured to prevent movement.
J. See Architectural drawings for exact locations of fixtures.
K. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

A. Clean plumbing fixtures and equipment.

3.07 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.
B. Do not permit use of fixtures by construction personnel.
C. Repair or replace damaged products before Date of Substantial Completion.
D. All fixtures subject to damage prior to completion of building shall be protected in an approved manner. Job must be turned over to Owner with all fixtures clean and free from damage.

3.08 *SCHEDULES*

A. Fixture Heights: Install fixtures to heights above finished floor as indicated.
    1. Water Closet:
        a. Standard: 15 inches (380 mm) to top of bowl rim.
        b. Accessible: 18 inches (455 mm) to top of seat.
    2. Water Closet Flush Valves:
        a. Standard: 11 inches (280 mm) min. above bowl rim.
        b. Recessed: 10 inches (255 mm) min. above bowl rim.
    3. Urinal:
        a. Standard: 22 inches (560 mm) to top of bowl rim.
        b. Accessible: 17 inches (430 mm) to top of bowl rim.
    4. Lavatory:
        a. Standard: 31 inches (785 mm) to top of basin rim.
        b. Accessible: 34 inches (865 mm) to top of basin rim.
    5. Drinking Fountain:
        a. Child: 30 inches (760 mm) to top of basin rim.
        b. Standard Adult: 40 inches (1015 mm) to top of basin rim.
        c. Accessible: 36 inches (915 mm) to top of spout.
    6. Shower Heads:
        a. Adult Male: 69.5 inches (1765 mm) to bottom of head.
        b. Adult Female: 64.5 inches (1640 mm) to bottom of head.
        c. Child: 58.5 inches (1490 mm) to bottom of head.
    7. Emergency Eye and Face Wash:
        a. Standard: 38 inches (965 mm) to receptor rim.
    8. Emergency Shower:
        a. Standard: 84 inches (2130 mm) to bottom of head.
B. Fixture Rough-In
    1. Water Closet (Flush Valve Type):
        a. Cold Water: 1 Inch (25 mm).
        b. Waste: 4 Inch (100 mm).
        c. Vent: 2 Inch (50 mm).
    2. Urinal (Flush Valve Type):
        a. Cold Water: 3/4 Inch (20 mm).
        b. Waste: 2 Inch (50 mm).
        c. Vent: 1-1/2 Inch (40 mm).
    3. Lavatory:
        a. Hot Water: 1/2 Inch (15 mm).
        b. Cold Water: 1/2 Inch (15 mm).
        c. Waste: 1-1/2 Inch (40 mm).
        d. Vent: 1-1/4 Inch (32 mm).
    4. Sink:
        a. Hot Water: 1/2 Inch (15 mm).
        b. Cold Water: 1/2 Inch (15 mm).
        c. Waste: 1-1/2 Inch (40 mm).
        d. Vent: 1-1/4 Inch (32 mm).
    5. Service Sink:
        a. Hot Water: 1/2 Inch (15 mm).
        b. Cold Water: 1/2 Inch (15 mm).

c. Waste: 3 Inch (80 mm).
d. Vent: 1-1/2 Inch (40 mm).

6. Drinking Fountain:
   a. Cold Water: 1/2 Inch (15 mm).
   b. Waste: 1-1/4 Inch (32 mm).
   c. Vent: 1-1/4 Inch (32 mm).
7. Bathtub:
   a. Hot Water: 1/2 Inch (15 mm).
   b. Cold Water: 1/2 Inch (15 mm).
   c. Waste: 1-1/2 Inch (40 mm).
   d. Vent: 1-1/4 Inch (32 mm).
8. Shower:
   a. Hot Water: 1/2 Inch (15 mm).
   b. Cold Water: 1/2 Inch (15 mm).
   c. Waste: 1-1/2 Inch (40 mm).
   d. Vent: 1-1/4 Inch (32 mm).

DIVISION 23 00 00 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

PART 1 GENERAL

The Architect/ Engineer shall determine the best HVAC system for the project with the focus on the equipment first (installed) cost, yearly maintenance, equipment replacement, annual energy costs, life cycle costs, learning environment control, and ease of maintenance including disruption to daily operations.

The contractor shall install equipment according to State & Shelby County Mechanical, Electrical, Plumbing codes, and manufacturer's installation instructions.

The contractor shall provide and install temporary cooling as necessary to achieve a comfortable climate for students and staff, including electrical provision and venting. Vent to exterior of building if possible.
Equipment shall not be demolished until new equipment is on-hand and ready to install.
All projects shall have a commissioning report. Report to be submitted as part of closing documents.

ANY NEW PROJECTS OR RENOVATIONS MUST INCLUDE NEW AND UPGRADED DDC CONTROLS FOR ANY NEW OR EXISTING HVAC EQUIPMENT FOR THE ENTIRE SITE. SEE SCOPE OF WORK FOR DETAILS AND/OR ALLOWANCES.

In the months of July and August prior to the start of Teacher's return, the Contractor is responsible for deep cleaning of all four walls, doors, floors and ceilings each time work is done in any space by a reputable vendor to ensure that the facility is ready to receive students and staff in preparation for start of school. Including movement of furniture out of areas of work and back into work areas. Coordinate and schedule cleaning efforts with MSCS custodial staff.

A new chemical system shall be provided for hydronic projects including Cooling Tower, Boilers and Chillers by current MSCS vendor to include solid release chemical feed system and control equipment including new pot feeders, controller, sensors, blow down, solenoid etc.

The selection of all HVAC systems and other systems shall be approved by the Owner at the schematic phase of design. Refer to MSCS preferred equipment list referenced in Appendix K.

All air and water balancing shall be done by an AABC or NEBB certified test and balance firm, which employs a registered qualified Engineer under contract with MSCS. The Mechanical Contractor shall coordinate with this balancing Contractor.

Quick connect fittings shall not be used.

Pro-Press, Pex piping or equivalent will not be accepted and will not be approved on any hydronic, gas, plumbing or refrigerant piping.
Re-heat or air blending systems shall only be used for special areas where dehumidification is required.

Air side economizer cycles shall be used where possible, for energy savings and the effect on health through the reduction of airborne bacteria count. Contact the Owner when a water side economizer is being considered.

Low leakage type outdoor air dampers shall be used to minimize air infiltration during off-hours. Maximum leakage of ½ of 1% at pressure differentials under 4" WG.

All duct mounted fresh air or outside dampers shall be controllable in BAS system.

Electric resistance heaters should only be used for comfort heating where indicated by a life cycle cost study to be most economical. However, electric heaters shall be used in all exterior mechanical rooms.

The main office area should be a single zone for the energy management system. Individual spaces should have thermostats for independent control. The HVAC system should be located where it can be serviced without disrupting the entire office area.

The fresh air system should be integrated into the heating and air conditioning system to avoid stale or offensive odors and CO_2 becoming concentrated. Special care should be taken in locating fresh air intake away from stack vents and toilet exhausts.

Provide full AC coverage for all storerooms in order to avoid mildew. The outside equipment storage should be ventilated to avoid build-up of flammable vapors and heated enough to prevent freezing of stored materials.

Exhaust Restrooms and vent their plumbing to prevent intake of the contaminated air by fresh air intakes.

The kitchen, IT Room, choral, band, gyms, cafeteria, offices, auditoriums, and community rooms should have its HVAC zoned separately from the rest of the building to allow for after-hours use. BAS shall install a room sensor in IT rooms for monitoring and high temp alarm.

Kitchen hood ventilators should have a fire extinguishing system, with gas cutoff and fire alarm connection, as appropriate and required by code.

Natural gas regulator ventilation - **NFPA 54/ANSI Z223.1 NATIONAL FUEL GAS CODE**

The vent shall be designed to prevent the entry of water, insects, or other foreign materials that could cause blockage.

An evaluation of any changes in site use and building envelope conditions, including new load calculations, shall be performed to determine the capacity of all new equipment (not default like for like).

All equipment shall be protected from electrical phase loss.

Emergency STOPS for mechanical equipment shall have hinged, non-lockable, clear, protective covers to prevent accidental shut-down.

Designers shall specify engraved plastic laminated labels on all equipment. See *DIVISION 22 05 53* - PLUMBING IDENTIFICATION. Labels shall include equipment number, area(s) served, number and size of filters and capacity. Use actual room numbers used at the facility - not architectural room numbers. The following are examples of labeling to be used:

Air Handling Units
AHU #1 (Classrooms 10 & 12) S.C.: 11/16/94 Filters: 2 - 24”x24”x1” Capacity: 2000 CFM @0.5” ESP

Boilers
Boiler #1 (Buildings 100 & 200) Input: 1,000 MBH Output: 900 MBH

Chillers
Chiller #1 (Buildings 100 & 200) Capacity: 190 Tons

Condensing Units
CU #1 (Classroom 10 & 12) Capacity: 5 Tons

Cooling Towers
CT #1 (Chiller #1) Capacity: 190 Tons

Fans
EF #1 (Toilets 110 &112) Capacity: 500 CFM @ 0.3" ESP

Pumps
BP#1 (Boiler #1) Capacity 200 GPM @ 50 FT.

Roof Top Units
RTU#1 (Classrooms 10) Filters: 8 – 24"x24"x2" Capacity: 5 Tons

FUEL SOURCES: Engineer shall determine most cost and energy efficient fuel source based on current and projected energy costs.

DESIGN CONDITIONS AND ENERGY USAGE: All new work shall comply with the applicable energy code. The design team shall submit the "Building Energy Performance Criteria" and "Energy Summary" to the Owner.

Provide estimates of monthly energy use in BTU/SF and cost/SF by fuel type, using current unit fuel cost, at the design development and working drawing phases of the design to the Owner.

SUMMER DESIGN CONDITIONS		WINTER DESIGN CONDITIONS	
Indoor 50%RH	72 degrees F,	Indoor DB	72 degrees F
Outdoor	96 degrees F DB 78 degrees F WB	Outdoor DB	10 degrees F
Load Calculation Safety Factor = 0%		Load Calculation Safety Factor = 10%	

VENTILATION: Each building or portion shall have the capability to provide ventilation in accordance with ASHRAE 62, based on building classification and occupant load. Special thermostatically controlled ventilation should be provided in boilers and mechanical rooms to prevent excessively high temperatures.

Compliance with ventilation codes shall be pursuant to the Indoor Air Quality Procedure and employ outside air mitigation strategies, such as the use of ionizers or demand ventilation.
All spaces that produce dust, such as the cabinetry labs, etc., shall be negatively pressurized to assist in reducing the infiltration of dust to adjacent spaces. Also, the mechanical systems for these spaces should have easily replaceable filtration systems.

The heating of make-up air for welding shops is not recommended from an economic standpoint.
Work areas for internal combustion engines shall have provisions so that exhaust gases can be exhausted directly to the outside by a carbon monoxide exhaust system.

Paint spray rooms shall have special treatment with respect to ventilation and safety requirements. Paint spray booths, commercial type, are recommended. If the booth is not to be used and a paint spray room is desired, the designers shall investigate thoroughly with respect to codes and standards.

The storage of flammable or combustible liquids shall be in UL-labeled cabinets with mechanical ventilation, or in storage rooms designed for the purpose. If a flammable or chemical storage room is needed, the designers shall investigate thoroughly with respect to codes and standards.

It is recommended that a separately switched exhaust fan be provided for each chemistry or IPS science laboratory and be of such capacity to quickly remove objectionable odors. A fan is not needed in a separate physics lab. An exhaust fan (with a hood if not in a dedicated kiln room) shall be provided at all kiln locations.

A separate air exhaust system shall be provided for all locker/dressing rooms. Air shall be re-circulated during unoccupied hours and exhausted during occupied hours. Switchovers by an occupancy sensor is recommended.
Mechanical ventilation shall be provided for all toilet rooms, for janitor's closets, and for storage rooms where

odors could become a problem. Group toilets shall have 2 CFM per square foot minimum ventilation. Provisions shall be made to prevent sound transmission through any common duct system serving more than one area, such as adjoining rooms.

Exhaust fans must be disabled when mechanical system is UNOCCUPIED unless special conditions dictate an Owner is informed well in advance of these criteria.

KITCHEN: Automatic wet chemical fire extinguishing systems shall be installed in all hoods as required by code. Ansul is an acceptable system for the basis of design. Upon activation of the extinguishing system, all fuel shall be shut off, whether gas or electric, and will include fuel to all equipment under the hood, including fryers, broilers, griddles, and ranges. Make-up air shall be shut off, but exhaust fans shall continue exhausting. Exhaust fans shall have an adjustable high limit shutdown switch normally set at 350°F.

Range hood roof exhaust fans shall be designed to prevent air from being discharged down toward the roof. All kitchen hoods shall have 80% minimum outside make-up. Deliver heat only, unless required by code, air at the perimeter of hoods.

MISCELLANEOUS HVAC ITEMS: Electric unit heaters with built-in thermostats shall be installed in all mechanical rooms in lieu of hot water unit heaters.

Provide dehumidification control in all media centers, libraries, and auditoriums to control and reduce relative humidity.

Electrical contractors shall provide and install surge protectors and lightning arrestors for all RTUs, VFDs, chillers, and Cooling Towers.
All chilled water shall be selected based on a chilled water temperature of 2 degrees higher than that leaving the chiller. Show all selection data in a coil schedule on drawings. All air handling units and ventilating units with hydronic coils shall have freeze protection with BAS feedback alarm for both CW and HW coils.

All HVAC equipment shall be selected for low noise levels. The units shall not exceed 45dBA in an empty classroom. The HVAC systems shall be provided with a complete labeling system for all equipment. Specify that all refrigeration compressors have 5-year material warranty.

Locate all cooler and freezer condensers outside the building on reinforced concrete pads at ground level, protected and fenced for maximum ventilation or located on the roof.

There shall be no open-flame heaters, open-coil electric heaters, or spark-producing electric components in areas likely to be used for spray painting or where there will be open containers of gasoline or other explosive vapor or dust.

Each hot water boiler shall have a low-water cutoff. Low-water cutoff should be manually reset type. Equipment shall be ASME Code-stamped, AGE-labeled, or UL-labeled as and when applicable.
Hot water relief valves and refrigerant relief devices must be piped to locations to minimize danger to personnel or students upon relief. Hot water relief valves should be piped to funnel-type floor drains located near the equipment.

Filters for all air handling equipment shall be standard size, manufacturer approved, and disposable type. Filter racks must support filters from both sides and must have closure panels. Filters must be readily accessible and require no tools to change. Specify that any questionable means of access will be replaced at no additional cost to the Owner.

All major items of mechanical equipment that employ any solid-state electronic components shall be fully protected from electrical surges and lightning.

Remove, replace or add cut-off valves for each piece of mechanical equipment being replaced.
For all hydronic heating/cooling systems, provide manual shut off valves at the point where main supply and

return lines leave the central mechanical room, where piping leaves and/or enters a building and in mains such that classroom wings can be isolated. Provide isolation valves for all mains.
Do not locate AHUs in same room as boilers.

Electronic thermostats using battery backup shall do so only to maintain memory. Thermostats that draw down the battery during power outages through other loads are not acceptable.

Libraries are required to have dehumidification.

All chilled water and hot water systems shall be constant flow, primary/secondary.

WARRANTY: See *DIVISION 01 78 00* - SPECIAL WARRANTIES AND MAINTENANCE AGREEMENTS for information about HVAC service contracts.
HVAC Replacement Projects:
Where none exists, isolation (ball) valves shall be added for zones, floors and/or terminal equipment to eliminate the need to fully drain a hydronic system for maintenance.

The electrical subcontractor on an HVAC project shall be charged with providing power to all energy management equipment requiring power of 96 volts or greater.

The electrical contractor on an HVAC project shall be charged with installing any high voltage device (96 volts of greater) provided by the energy management vendor, such as a digital energy monitor (DEM), if one or any are called for in the project documents.

If a non-Siemens BACnet controller is provided, two (2) manufacturer service tools and one (1) field-grade laptop shall be provided to MSCS.

Natural gas regulator ventilation - **NFPA 54/ANSI Z223.1 NATIONAL FUEL GAS CODE**
The vent shall be designed to prevent the entry of **water**, insects, or other foreign materials that could cause blockage.

An evaluation of any changes in site use and building envelope conditions, including new load calculations, shall be performed to determine the capacity of all new equipment (not default like for like).
All equipment shall be protected from electrical phase loss.

If outside air is connected to an existing fan coil unit, the unit shall be replaced with a unit ventilator for proper conditioning and moisture removal in the space. Fan coil units are not the correct product when used to condition fresh air for a space or classroom.

Provide and install P/T ports, isolation valves, pressure/temperature gauges, drain valve to supply and return piping at each chiller for both evaporator and condenser. Provide and install P/T ports, isolation valves, pressure/temperature gauges, drain valve to supply and return piping at each boiler and cooling tower.

The contractor is to provide and install connections with isolation valves for temporary hook up of chillers and towers for every project.

All equipment shall have a visible, UV protected label to display unit tag, room #, Instance number, and MAC address, location and tag of the breaker panel on the exterior of each unit. This is the responsibility of the mechanical contractor.

All pipes to be tagged and have an arrow clearly displaying proper direction of flow.

Provide and install sock filters for chiller pump, boiler pump, and main system pumps for both closed and open systems.

If new chemical equipment is requested new system should match existing chemical feed at MSCS.

All pumps repaired and replaced to be laser aligned. Reports must be provided with closing documents.

All drive motors and fans to be dynamically balanced. Submit report with closing documents.
All projects shall have a certified balance report. Report to be submitted as part of closing documents.

Maintain average temperatures in sedentary academic areas between 68 heat and 72-cooling degrees Fahrenheit in summer and 72 heat and 76 cooling in winter.

All air handling units shall have direct drive EC fans. Belt drive is not acceptable due to additional required maintenance. Each air handling unit shall have a minimum of two EC fans for redundancy.

Provide access sections with min of 18 inch hinged doors for all coil sections.
Identify any existing controls that will be made obsolete by the new project and address them as necessary.
All existing proprietary non-BACnet controls shall be upgraded to new BACnet Web-Based stand-alone EMS standard per *Division 25 50 00* included in this guideline.

MSCS PREFERRED HVAC MANUFACTURERS PER EQUIPMENT TYPE:
List below is for reference and not meant to be exclusive of any manufacturer.

Equipment	**Manufacturer**	**Manufacturer**	**Manufacturer**
Pumps	B&G	Grundfos	Armstrong
Boilers	Lochinvar	Patterson- Kelley	Cleaver Brooks
Cooling Towers	Reymsa	Marley	Evapco
Variable Frequency Drives	ABB	Emerson	Siemens
Plate Frame Heat Exchangers	B&G	Armstrong	Evapco
Controls	**Siemens Talon/Desigo Automation**	**JCI, Metasys**	**Trane, Tracer**
Chillers	Daikin	Carrier	Trane
Unit Ventilators/ SCUV	Daikin	Magic Aire	Trane
Roof Top Units	Lennox	Carrier	Trane
Dedicated Outdoor Air Unit	Daikin	Carrier	Trane
Split Systems DX	Daikin	Mitsubishi	Carrier
Fan Coil Units	Daikin	Carrier	Trane

1.01 RELATED DOCUMENTS

A. Drawings and the General Conditions, Instructions to Bidders, and all other general requirements of these specifications shall be considered a component of this division of the specifications.
B. This section of the specifications includes general provisions applicable to all work of *Divisions 21, 22 and 23.*
C. This Contractor shall examine all other divisions of the specifications and all drawings for the project and shall familiarize himself with all features of the project that may affect his work.

1.02 DESCRIPTION OF WORK

A. Materials, equipment, fabrication, installation, and tests in conformity with applicable codes and authorities having jurisdiction for the following:
   1. Mechanical work covered by all sections within Divisions 22 and 23 of these Specifications, including but not limited to:
      a. Plumbing systems and equipment.
      b. Heating, ventilating, air conditioning and refrigeration systems and equipment.
B. This section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:

1. Reference Standards, Codes and Fees
2. Quality Assurance
3. Submittal
4. Maintenance Manuals
5. Job Conditions
6. Accuracy of Data and Drawings
7. Electrical Requirements for Mechanical Equipment
8. Coordination Drawings
9. Record Documents
10. Identification
11. Rough-ins
12. Field Tests
13. Excavation and Backfill
14. Adjusting and Cleaning
15. Installation
16. Removal and Relocation of Existing Work
17. Painting
18. Firestopping

C. Related Work:
1. *Division 03* - Concrete
2. *Division 05* - Metals
3. *Division 07* - Thermal and Moisture Protection
4. *Division 09* - Finishes
5. *Division 26* - Electrical

1.03 REFERENCE STANDARDS, CODES AND FEES

A. In addition to requirements of *Divisions 00 and 01* - CONTRACT REQUIREMENTS and GENERAL REQUIREMENTS; install work to comply with requirements of:
1. Local Codes
2. State Codes
3. Federal Codes
4. 2018 International Building Code
5. 2018 International Fire Prevention Code
6. 2018 International Mechanical Code
7. 2018 International Plumbing Code
8. 2018 International Gas Code
9. AABC - Associated Air Balance Council
10. AGA - American Gas Association
11. ANSI - American Society National Standards Institute
12. ARI - Air-Conditioning and Refrigeration Institute
13. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
14. ASME - American Society of Mechanical Engineers
15. ASME Boiler Code
16. NEBB - National Environmental Balancing Bureau
17. NEMA - National Electrical Manufacturer's Association
18. NFPA - National Fire Protection Association
19. OSHA - Occupational Safety and Health Act
20. SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Inc.
21. SMACNA HVAC Duct Construction Standards
22. UL - Underwriters Laboratories, Inc.

B. The Contractor shall obtain and pay for all licenses and permits required to perform work covered by *DIVISIONS 21, 22 and 23*, and obtain and pay for all necessary inspections by all applicable authorities.

1.04 QUALITY ASSURANCE

A. The use of manufacturer’s names and catalog numbers in these specifications or on the drawings indicates the type, size, rating, capacity, design, quality, or kind of materials required and a closed specification is not intended, and similar and equal products of any reputable

manufacturer which will satisfactorily perform the required functions will be acceptable, unless otherwise indicated by the words NO SUBSTITUTES, or unless otherwise specifically stated. The Architect/Engineer reserves the right to reject all materials which he deems not equal to those specified, or which he decides will not satisfactorily perform the required functions.

B. Supply all equipment and accessories new and free from defects.
C. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
D. Supply all equipment and accessories in compliance with the applicable standards and with all applicable national, state, and local codes.
E. When included, reflected ceiling plan drawings shall govern over mechanical and electrical drawings for location of ceiling-mounted elements.
F. In addition to all requirements specified hereinafter, each material and equipment item shall have all features as standard with its manufacturer and/or required for the complete operational system.
G. Capacities, ratings, sizes and other requirements not specified hereinafter shall be as scheduled or otherwise indicated on the drawings.
H. Should the Trade Contractor at any time discover a discrepancy between engineering and architectural drawings or with respect to a variance of code requirements, he shall notify the Architect/Engineer for clarification and shall not proceed with the work affected until clarification has been made.

1.05 SUBMITTALS

A. Submittals and shop drawings shall be submitted in accordance with *Division 01* – CONTRACT and GENERAL REQUIREMENTS and in accordance with the following:
   1. All equipment, material, and manufacturer's literature shall be submitted for approval at one time and in a tabulated high quality 3 ring binder. Control drawings and the controls equipment submittal may be submitted at a later time, but as soon as practical after the contract has been awarded and after the general equipment submittal has been made. However, every attempt shall be made to include the complete controls submittal with the general equipment submitted at one time.
   2. The submittal shall include summary cover sheet(s) and manufacturer's literature under each tab of the submittal binder which together clearly indicate compliance or deviation from the specifications and drawings. Each submittal brochure shall be signed on the index page by the Contractor. This signature shall indicate the Contractor has examined all data therein and found same to be in order.
   3. Submission material and all shop drawings shall be marked up with the appropriate identification relating the equipment to the drawings. Mark and reference each item on the submittal summary sheet and the manufacturer's literature to the appropriate paragraph number in the specifications. Manufacturer's standard catalogs will not be accepted.
   4. Failure to comply with the above for a complete and clear submittal will result in a re-submittal.
   5. Provide number of copies for review as specified in *DIVISION 01*.

B. Maintenance Manuals:
   1. Prepare maintenance manuals in accordance with *Division 01 79 00* "CLOSEOUT SUBMITTALS." In addition to the requirements specified in Division 1, include the following information for each equipment item. Behind a separate tab for each piece of equipment, provide the following:
      a. A copy of the equipment submittals and shop drawings as provided in (A) above.
      b. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
      c. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions, as applicable.
      d. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
      e. Servicing instructions and lubrication charts and schedules.

2. Before requesting acceptance of work, furnish the number of printed and bound sets required in *DIVISIONS 01*.
3. Furnish detailed and simplified one-line, color coded flow and wiring diagrams.
4. Furnish a schedule of valve identification.
5. Provide two (2) copies of all manuals.

C. Field test report as required by *23 05 12* - Testing, Adjusting, and Balancing for HVAC. Provide number of copies specified in *Division 01*.

1.06 JOB CONDITIONS

A. Examine related work and surfaces before starting work of any section.
1. Report any conditions which will prevent proper provision of this work to the Architect/Engineer.
2. Installed work which interferes with architectural or any other work, or which deviates from drawings and specifications without Architect/Engineer's prior approval, shall be altered, without cost to the Owner, to clear such interferences, or to comply with the drawings and specifications. Interferences or discrepancies which may be discovered or anticipated shall be reported promptly to Architect/Engineer for his decision before proceeding with the work involved. Architect/Engineer shall have privilege of making minor changes without additional cost, provided that such changes are made before commencing work on items involved.

B. Continuity of Services and Connections to Existing Work:
1. At no additional cost to the Owner, provide all necessary temporary connections and temporary facilities to accomplish the required continuity of services and existing operations.
2. Arrange all work to interfere as little as possible with the normal existing operations. Do not interrupt any existing utility or other service or existing operation at any time without Owner's prior approval. After each interruption has been made, make all necessary connections and alterations and restore services and avoid interferences with normal existing operations as quickly as possible.
3. Install new work and connect to existing work with minimum interference to existing facilities and maintain water and air tightness when applicable.
4. Temporary shutdowns of existing services:
   a. At no additional charges.
   b. At times not to interfere with normal operation of existing facilities.
   c. Only with written consent of Owner.
5. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work.
6. Connect new work to existing work in neat and satisfactory high quality workmanship manner.
7. Restore existing disturbed work to original or better conditions.

1.07 ACCURACY OF DATA AND DRAWINGS

A. Drawings are generally diagrammatic, and where not dimensioned or detailed, indicate approximate locations of work. Examine carefully existing buildings and structures, existing systems, and all other contract drawings, and install work to conform as nearly as possible to locations and arrangements indicated, with only such minor adjustments as necessary to coordinate work with architectural and other work, and to avoid interferences therewith. All piping and ductwork, offsets, risers, and fittings are not necessarily shown; however, provide these as required by the conditions involved.

B. Building and structure dimensions:
1. Take these from Architectural and Structural Drawings.
2. Take these from actual measurements made by Contractor of each existing building and each existing building and each existing structure involved.

1.08 ELECTRICAL CHARACTERISTICS, MOTOR SIZES, MOTOR STARTERS, CONTROLS, AND WIRING

A. Motor starters and other electrical control devices: This section shall furnish all motor starters which may be specified hereinafter within this or other sections of DIVISION 23. Also, this section shall furnish all other electrical control devices required for the Mechanical system,

unless otherwise specified.

B. Installation of electrical devices, EXCEPT those factory mounted on equipment: electrical control devices which require electrical connections ONLY, shall be installed by DIVISION 26 - ELECTRICAL. All control devices which are not factory mounted on the equipment and require piping, linkage, remote bulb, or other mechanical connections as well as electrical connections shall be installed by the Section that furnished the equipment involved, ready for electrical connection.
   1. Electric wiring: *Division 23* shall perform any and all control and interlock wiring necessary for the operation sequence described in *Division 23* or on mechanical plans with properly licensed personnel. Any wiring requirements for control devices furnished under *Division 23* shall be provided by *Division 23*. Wiring for control devices not furnished by *Division 23* or devices that are factory mounted on mechanical equipment requiring electrical connections only shall be by *Division 26*. *Division 26* shall provide dedicated 120 VAC, 15-20 amp power to designated control panel locations. Exact locations shall be coordinated between *Division 23 and 26*.
   2. All necessary interlocking contacts and remote starting contacts and remote starting devices not installed on local control panels shall be supplied with the starters and it shall be the responsibility of *Division 23* to coordinate the number of contacts required. If individual control transformers are required, provide the transformers necessary for the additional power required by auxiliary control devices. This coordination shall occur prior to ordering starters and the cost shall be included in the bid proposal.
   3. Control wiring materials and installation shall conform to *Division 26* requirements.

1.09 COORDINATION DRAWINGS

A. Prepare coordination drawings in accordance with *Division 01 20 00*, to a minimum scale of 1/4" = 1'- 0" or larger if required in Division 1; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:
   1. Indicate the proposed locations of piping, ductwork, equipment, and materials in all mechanical equipment rooms [and 20 feet in all directions of mechanical chase(s)]. Include the following:
      a. Clearances for installing and maintaining insulation.
      b. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
      c. Equipment connections and support details.
      d. Exterior wall and foundation penetrations.
      e. Fire-rated wall and floor penetrations.
      f. Sizes and location of required concrete pads and bases.
   2. Project drawings for mechanical and plumbing systems will be made available to the contractor in Autocad 2010 format for use in coordination drawings.

1.10 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in *Division 01 79 00* "CLOSEOUT SUBMITTALS." In addition to the requirements specified in Division 01, indicate the following installed conditions:
   1. All ductwork, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
   2. All piping with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.) Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
   3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
   4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
   5. Contract Modifications, actual equipment and materials installed.

6. These documents shall be prepared in Autocad 2010 format and provided with project closeout documentation in disk, electronically and hard copy format.

PART 2 PRODUCTS

2.01 VALVE TAG IDENTIFICATION

A. Minimum 1-1/2-inch diameter.
B. Brass or aluminum.
C. Identifying numbers and letters shall be stamped 1/4-inch (minimum) height.
D. Fasten to valve with 18 (minimum) gauge solid copper or galvanized steel wire.

2.02 EQUIPMENT IDENTIFICATION

A. Four by two-inch (minimum) size engraved and laminated plastic nameplate or black lamicoid sheet with white lettering.

2.03 PIPE IDENTIFICATION

A. Pipe identification shall be self-sticking vinyl cloth markers and pipe marker arrows equal to Brady B-500 or plastic snap-around arrows and pipe markers equal to Seton "Set Mark".

2.04 DAMPER IDENTIFICATION

A. Provide damper tags on each balancing damper located in Ventilating (Indoor Air Quality) Air System.

2.05 WARNING TAPE FOR BURIED PIPE

A. Tape shall be Reef Industries, Inc., "Terra Tape D", Seton Detection Tape or as approved, composition metalized foil-plastic film laminate bearing imprint describing the type of buried pipeline.
B. All materials shall be specifically formulated for prolonged use underground.

PART 3 EXECUTION

3.01 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
B. Refer to equipment specifications in Divisions 2 through 26 for rough-in requirements.

3.02 FIELD TESTS

A. All piping shall be free of leaks, and test gauges shall show no loss of pressure for at least 30 minutes, after source of test pressure has been cut off, or as noted. Pipes may be tested in sections as the work progresses. Repair and retest all sections failing to pass tests, as required to obtain approval of tests. No caulking, welding or brazing will be permitted on threaded pipe or fittings to stop leaks. Replace with new material all cracked or otherwise defective pipe and fittings of all types, as approved. Furnish suitable testing equipment, give the Architect/Engineer and all applicable authorities ample advance notice of all proposed tests and readiness of work for inspections, and conduct each test in their presence, as approved. Do not conceal or insulate piping and do not conceal ductwork until all inspections have been made and all required tests have been approved by the Architect/Engineer and all applicable authorities. Submit results for review.
B. Provide required labor, material, equipment and connections.
C. Test all piping, EXCEPT as otherwise specified below, as follows: hydrostatic test, at 150 percent of normal operating pressure of piping involved, or 100 psi, whichever is higher, AFTER removing all air from piping involved in test.
    1. Natural gas: Shall be tested as specified in Section 22 1005.
    2. Refrigerant piping: Shall be tested as specified in Section 23 2300.
    3. Soil, waste, vent roof drainage, domestic water and acid waste piping: Shall be tested as specified in Section 22 1005.
    4. Test all equipment in accordance with sections specified hereinafter.
    5. Test all ductwork in accordance with leakage test methods recommended in SMACNA "HVAC Duct Construction Standards".
    6. Total system leakage shall not exceed values indicated therein.
    7. The Testing and Balancing agency shall measure and record the results of the leakage test for all duct systems, assist in identifying leakage locations and report test results to the Contractor, Architect/Engineer, and the Commissiong Agent.
    8. Contractor shall seal all applicable openings, separate duct sections that exceed the limitations of the test apparatus, provide connections for test apparatus, give reasonable

notice to the Testing and Balancing Agency when sections are ready for testing and take corrective action to seal the ductwork.

3.03 EXCAVATION AND BACKFILL

A. Excavation, Underground Piping:
   1. Cut trenches to indicated and/or required lines, and to depths which will:
      a. Provide full length bearing of pipe barrels on firm ground.
      b. Provide 24-inch MINIMUM earth cover over all pipes outside of buildings and structures.
   2. Piping shall be laid on a six-inch bed of sand.
   3. Seat pipe on sand fill as required to facilitate jointing, and to prevent pipe hubs, couplings and valves from bearing on sand before backfilling.
   4. Sheet and brace excavations as required to prevent cave-ins and protect personnel and adjacent structures.
   5. Where pipelines are below footings, horizontal distance between footings and pipelines shall be as required to provide not steeper than a 1:1 slope from footing bottoms to trench bottoms at all points.

B. Backfill, Trenches:
   1. After each pipeline has been laid, tested and approved, thoroughly hand tamp backfill into bell holes, around pipe, and up to six inches above pipe top.
   2. Place remaining backfill in 8 inches maximum thickness loose layers, and with pneumatic or other suitable power tampers compact each layer.
   3. Backfill materials shall be of the following types:
      a. Up to six inches above pipe tops: sand, ONLY.
      b. From six inches above pipe tops up to finished grade or subgrade, as required:
         1) Any materials removed from the excavation and suitable for backfill, except do no use as backfill material any pieces of the following material which are larger than six inches in their greatest dimensions: rock, stone, concrete, asphalt paving, or masonry.
         2) Dispose of excavated materials which are not replaced as backfill, as approved.

C. Unsuitable Subsurface Conditions:
   1. Where excavation bottoms at required elevations are found to be unstable, or where rock, cinders, rubbish, or other deleterious materials are encountered, extend excavations down to firm earth, but at least six inches below deleterious materials.
   2. Bring excavation bottoms back up to required pipe laying subgrade by backfilling with suitable material, thoroughly compacted in place as specified above.
   3. "Suitable material" shall be as specified above.
   4. Dispose of excavated unsuitable subgrade materials, as approved.

D. Warning Tape for Buried Pipeline: Install detectable warning tape directly over every exterior pipeline by burying tape as close to the surface as possible, but no less than six inches beneath finished grade.

3.04 ADJUSTING AND CLEANING

A. Flush or blow all welding slag, pipe joint compound, loose scale, and other debris from pipework before connecting equipment thereto.

B. After systems have been tested and before any field painting commences, clean up all work thoroughly. Remove all foreign matter which has accumulated in ducts, casings, enclosures, fixtures, and equipment. Clean and polish all valves, plates, and other surfaces that are not to be painted, so that they present a new and acceptable appearance.

C. Put systems in operation, test all fixtures and other equipment, remedy all leaks and defects, make all necessary adjustments, and remove all air from water circulating systems.
Adjust all air and water flows to indicated and/or required quantities, and adjust all controls and other items as required to balance system and provide uniform air flows and uniform temperatures in air conditioned areas. Demonstrate that all controls and mechanical equipment function satisfactorily, as specified, as indicated, and as approved.

D. Strainers and Dirt Pockets: Clean out each of these; REMOVE EACH STRAINER SCREEN FOR CLEANING. Initially install very fine mesh screen for system cleaning and operate System to a minimum of 24 hours. Remove screen, clean it and replace it in system until a clean system

is verified. Remove screen and replace with screen at mesh for normal operation.

E. Circulating Water Systems: Completely drain each of these, and refill with clean water.

F. After systems have been tested and before putting any part of or the entire system in operation for Owner's beneficial use, ensure that all necessary adjustments have been made.
   1. Bearings and other items requiring lubrication, except factory permanently lubricated type: lubricate each of these as recommended by its manufacturer; this includes lubricated type plug valves.
   2. Belts: adjust each of these to proper tension.
   3. Filters: replace each disposable ("throw away") filter with a new clean filter (except blanket roll and high efficiency type). Clean each cleanable filter. NOTE: ALL FILTERS SHALL BE IN PLACE DURING TESTING AND ADJUSTING AND SHALL BE CLEAN.
   4. Motor load tests: make an ammeter check of actual running current of each motor in mechanical system under operating conditions. Correct all motors that are found to be overloaded, as approved.

3.05 INSTALLATION

A. General: Sequence, coordinate and integrate the various elements of mechanical systems, materials, and equipment.

B. Equipment rooms and other areas in which equipment is to be installed have limiting dimensions. Coordinate mechanical systems, equipment, and materials installation with other building components. Install all mechanical work within these areas substantially as indicated, with ample unobstructed access space around each piece of equipment to facilitate proper installation, operation, and maintenance of equipment, and to allow ample space for plumbing, electrical, and other equipment indicated to be installed therein. Minor revisions in layout may be made subject to Architect/Engineer approval, but major changes in layout to accommodate proposed equipment which differs substantially from specified equipment in size and arrangement will not be considered. Each bidder shall determine before bidding that equipment upon which he proposes to base his bid will conform to these requirements. Install each equipment item in accordance with its manufacturer's recommendations, and as indicated on the drawings, and/or specified. If the drawings and/or specifications conflict with the manufacturer's recommendations, report this to the Architect/Engineer for his decision before proceeding with the work involved.

C. Equipment NOT furnished by mechanical section but requiring mechanical connections from other Sections and others furnishing this equipment, determine exact mechanical connection requirements; therefore, locations and arrangements of connections indicated for this equipment are APPROXIMATE ONLY.

D. Arrange for chases, slots and openings in other building components during progress of construction, to allow for mechanical installations.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

F. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.

G. Where installation heights are not detailed or dimensioned, and equipment requires periodic service, verify height with Owner prior to installation, otherwise install to provide the maximum headroom possible.

H. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.

I. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

J. Install systems, materials and equipment giving right-of-way priority to systems required to be installed at a specified slope.

K. Generally, install piping and ductwork as follows unless otherwise indicated.
   1. Finished areas: conceal piping and ductwork within pipe chases, above suspended ceiling

and within other building construction, in offices, rest rooms, and other finished areas, unless otherwise indicated.

2. Unfinished areas: install above ground piping and ductwork exposed in areas where pipe chases or suspended ceilings are not indicated or concealing is otherwise impracticable, in mechanical and electrical equipment rooms or storage areas, and other unfinished areas.
3. ALL areas: install piping and ductwork parallel or at right angles with beams, walls, ceilings, and other building lines, in straight lines between required direction changes, with vertical runs plumb. Install exposed piping and ductwork as close as practicable to walls, columns, ceilings, and overhead construction, and to provide maximum headroom and minimum interference with usable building space.

3.06 PAINTING

A. Painting of systems, equipment and components is specified in Division 09.
B. Where galvanizing is broken during fabrication or installation, recoat exposed areas with cold galvanizing compound.
C. Marred surfaces of prime coated or factory painted surfaces shall be painted and/or primed to match adjacent coat.

3.07 IDENTIFICATION OF VALVING AND EQUIPMENT

A. Identify valves, (including main pipe sectionalizing valves and branch valves) except those on or within hand reach of equipment controlled thereby with a minimum 1-1/2 inch diameter round brass or aluminum tag stamped with 1/4 inch (minimum) height letters designating material controlled by valve, and attached to valve body with 18 (minimum) gauge solid copper or galvanized steel wire. Submit a typed valve identification schedule with the operating instructions and parts list submittal described above under 1.05 SUBMITTALS.
B. Equipment: Label each major mechanical equipment item (such as AHU, pump, fan, condensing unit, boiler, water heaters, etc.) with nameplate engraved with equipment designation and number, and securely attached to equipment. Label each VAV box and fan coil unit on the underside of the equipment.

3.08 IDENTIFICATION OF PIPING

A. Identify piping with each marker sized as recommended by manufacturer for outside diameter of pipe (including pipe insulation) labeled therewith. Marker background colors shall conform to OSHA, NFPA and ANSI pipe identification standards as scheduled in Table (I). Each pipe marker shall be lettered to indicate the material contained in the pipeline involved and arrows shall indicate direction of material flow in the pipelines.
B. Provide a full color piping Identification Schedule indicating material type within pipe and its corresponding color coding.
C. Locate Identification As Follows:
    1. Mechanical Equipment Rooms:
        a. Within 1'-6" of each valve or valve assembly.
        b. Within 3'-0" of each 90-degree elbow, connection to equipment or vessel, point where pipe enters shafts and pierces outside walls.
        c. On not over 20'-0" intervals along all exposed piping.
    2. Above Suspended Ceilings:
        a. Within 1'-6" of each valve or valve assembly.
        b. At tees within 3'-0" of both main and branch.
        c. Within 3'-0" of each 90-degree elbow.
    3. Piping Concealed in Chases or Shafts:
        a. Each pipe visible through an access door or panel.
    4. Piping Exposed in Rooms Other than Mechanical Equipment Areas:
        a. Omit identification of piping, 2" and smaller, exposed at connections to equipment or plumbing fixtures.
        b. With the above exception, identify at not less than (1) point each piping run visible in each room with identification on not over 20'-0" intervals.

TABLE 1 SCHEDULE OF PIPING IDENTIFICATION		
CLASSIFICATION	BACKGROUND COLOR	LETTERING
(PER ANSI A13.1)		
Domestic Cold Water	Green	White
Domestic Hot Water Supply	Yellow	Black
Domestic Hot Water Return	Yellow	Black
Equipment Drains, Roof Drains	Green	White
Fire Protection Water	Red	White
Natural Gas	Yellow	Black
Plumbing Vent Lines	Green	White
Sanitary Drains	Green	White
Storm Drains	Green	White

3.09 IDENTIFICATION OF DAMPERS

A. Damper tags shall be lettered to say: "THIS DAMPER HAS BEEN ADJUSTED TO MEET INDOOR AIR QUALITY STANDARDS. DO NOT TAMPER."

3.10 FIRESTOPPING

A. Fire-stopping of pipes, ducts and conduits penetrating fire-rated floors and partitions is specified in *Division 7*.

DIVISION 23 05 00 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Seismic control requirements.
   1. Includes requirements for seismic qualification of equipment not specified in this section.
B. External seismic snubber assemblies.
C. Seismic restraint systems.

1.02 RELATED REQUIREMENTS

A. *Division 01 40 00* - Code-Required Special Inspections and Procedures.
B. *Division 03 30 00* - Cast-in-Place Concrete.
C. *Division 05 50 00* - Metal Fabrications: Materials and requirements for fabricated metal supports.

1.03 DEFINITIONS

A. HVAC Component: Where referenced in this section in regard to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).
B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

A. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc; 2011.
B. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
D. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
F. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
G. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
H. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Seismic Controls:
      a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
      b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachments to concrete surfaces until concrete has fully cured in accordance with *Division 03 30 00*.

1.06 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
   1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
   2. Seismic Controls: Include seismic load capacities.

D. Shop Drawings - Vibration Isolation Systems:
   1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.

E. Shop Drawings - Seismic Controls:
   1. Include dimensioned plan views and sections indicating proposed HVAC component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
   2. Identify mounting conditions required for equipment seismic qualification.
   3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
   4. Indicate proposed arrangement of distributed system trapeze support groupings.
   5. Indicate proposed locations for distributed system flexible fittings and/or connections.
   6. Indicate locations of seismic separations where applicable.
   7. Include point load drawings indicating design loads transmitted to structure at each attachment location.

F. Seismic Design Data:
   1. Compile information on project-specific characteristics of actual installed HVAC components necessary for determining seismic design forces required to design appropriate seismic controls.
   2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

G. Certification for seismically qualified equipment; identify basis for certification.

H. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.

I. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

J. Evidence of qualifications for seismic controls designer.

K. Evidence of qualifications for manufacturer.

L. Manufacturer's detailed field testing and inspection procedures.
M. Field quality control test reports.

1.07 QUALITY ASSURANCE

A. Comply with applicable building code.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years' experience designing seismic restraints for nonstructural components.
    1. Designer may be employed by the manufacturer of the seismic restraint products.
D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
C. General Requirements:
    1. Select vibration isolators to provide required static deflection.
    2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
    3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
    4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
    5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch (50 mm) operating clearance beneath base unless otherwise indicated.
D. Equipment Isolation:
    1. Equipment as indicated on drawings:
        a. Location: Outdoor.
        b. Mounting: Vibration-isolated structural steel base.
        c. Base Depth: 6 inches.
        d. Isolator Type (Non-seismic Application): Restrained Spring isolators.
        e. Isolator Type (Seismic Application): Seismic type restrained spring isolators.

2.02 SEISMIC CONTROL REQUIREMENTS

A. Design and provide HVAC component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor HVAC components.
B. Seismic Design Criteria: As indicated on drawings.
C. Component Importance Factor (Ip): HVAC components to be assigned a component importance factor (Ip) of 1.5 unless otherwise indicated.
D. Seismic Qualification of Equipment:
    1. Provide special certification for HVAC equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
    2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
    3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
    4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.

E. Seismic Restraints:
1. Provide seismic restraints for HVAC components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction (AHJ).
2. Seismic Restraint Exemptions:
a. Exemptions for Seismic Design Category D, E, and F:
1) Discrete HVAC components that are positively attached to the structure where either of the following apply:
(a) The component weighs 400 pounds (1,780 N) or less, has a center of mass located 4 feet (1.22 m) or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor (Ip) is 1.0.
(b) The component weighs 20 pounds (89 N) or less or, in the case of a distributed system, 5 pounds per foot (73 N/m) or less.
2) HVAC piping with component importance factor (Ip) of 1.0 and nominal pipe size of 3 inch (80 mm) or less, or with component importance factor (Ip) of 1.5 and nominal pipe size of 1 inch (25 mm) or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
b. Duct System Exemptions, All Seismic Design Categories:
1) Duct systems not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control with component importance factor (Ip) of 1.0, where flexible connections or other assemblies are provided between duct system and associated components, where duct system is positively attached to the structure, and where one of the following apply:
(a) Trapeze supported duct with trapeze assemblies using 3/8 inch (10 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds (445 N) or less.
(b) Trapeze supported duct with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds (890 N) or less.
(c) Trapeze supported duct with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 24 inches (610 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds (445 N) or less.
(d) Hanger supported duct with individual rod hangers 3/8 inch (10 mm) or 1/2 inch (13 mm) in diameter not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds (220 N) or less.
2) Duct systems not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control, where there are provisions to avoid impact with other ducts or mechanical components or to protect ducts in the event of such impact, and where duct system is positively attached to the structure and has a cross sectional area of less than 6 square feet (0.557 sq m) and weighs 20 pounds per foot (292 N/m) or less.
c. HVAC Piping Exemptions, All Seismic Design Categories:
1) HVAC piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
(a) Trapeze supported piping weighing less than 10 pounds per foot (146 N/m), where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.

(b) Trapeze supported piping with trapeze assemblies using 3/8 inch (10 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds (445 N) or less.

(c) Trapeze supported piping with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds (890 N) or less.

(d) Trapeze supported piping with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 24 inches (610 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds (445 N) or less.

(e) Hanger supported piping with individual rod hangers 3/8 inch (10 mm) or 1/2 inch (13 mm) in diameter not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where pipe has a component importance factor (Ip) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds (220 N) or less.

3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
   a. ASHRAE (HVACA).
   b. FEMA 412.
   c. FEMA 413.
   d. FEMA 414.
   e. FEMA E-74.
   f. SMACNA (SRM).
4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
5. Seismic Type Vibration Isolators:
   a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
6. External Seismic Snubber Assemblies:
   a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
      Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
7. Seismic Restraint Systems:
   a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
   b. Use only cable restraints to restrain vibration-isolated HVAC components, including distributed systems.
   c. Use only one restraint system type for a given HVAC component or distributed system (e.g., ductwork, piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
   d. Size restraint elements, including anchorage, to resist seismic loads as necessary to

restrain HVAC components in all lateral directions; consider bracket geometry in anchor load calculations.

e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported HVAC component weight.

f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported HVAC component weight.

g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.

h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.

i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction other than panel points unless approved by project Structural Engineer of Record.

8. Ductwork Applications:

a. Provide independent support and seismic restraint for in-line components (e.g., fans, heat exchangers, humidifiers) having an operating weight greater than 75 pounds (334 N).

b. Positively attach appurtenances (e.g., dampers, louvers, diffusers) with mechanical fasteners.

F. Seismic Attachments:

1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:

a. Increase size of pad as required to comply with anchor requirements.

b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

G. Seismic Interactions:

1. Include provisions to prevent seismic impact between HVAC components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
3. Comply with minimum clearance requirements between HVAC equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

H. Seismic Relative Displacement Provisions:

1. Use suitable fittings or flexible connections to accommodate:

a. Relative displacements at connections between components, including distributed systems (e.g., ductwork, piping); do not exceed load limits for equipment utility connections.

b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.

c. Design displacements at seismic separations.

d. Anticipated drifts between floors.

2.03 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

A. Manufacturers:
   1. External Seismic Snubber Assemblies:
      a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
      b. Mason Industries: www.mason-ind.com/#sle.
      c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.

C. Seismic Snubbing Elements:
   1. Air Gap: Between 0.125 inches (3 mm) and 0.25 inches (6 mm) unless otherwise indicated.
   2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch (6 mm) thick; capable of being visually inspected for damage and replaced.

2.04 SEISMIC RESTRAINT SYSTEMS

A. Manufacturers:
   1. Seismic Restraint Systems:
      a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
      b. Mason Industries: www.mason-ind.com/#sle.
      c. Vibro-Acoustics: www.vibro-acoustics.com/#sle.
   2. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.

B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

C. Cable Restraints:
   1. Comply with ASCE 19.
   2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
   3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
   4. Use protective thimbles for cable loops where potential for cable damage exists.

D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with *Division 01 40 00* and statement of special inspections as required by applicable building code.

B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
   1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
   2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

C. Seismic special inspections include, but are not limited to:
   1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with the certificate of compliance.
   2. Installation and anchorage of vibration isolation systems for Seismic Design Categories C,

D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch (6.4 mm) or less between equipment support frame and seismic restraint; periodic inspection.

3. Verification of required clearances between HVAC equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.

D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.

E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Field-Welding (where approved by Architect): Comply with *Division 05 50 00*.

E. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

F. Seismic Controls:

1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.
2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
   Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch (3 mm), use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch (3 mm) or less.
3. Equipment with Sheet Metal Housings:
   a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
   b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
   c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
4. Concrete Housekeeping Pads:
   a. Size in accordance with seismic design to meet anchor requirements.
   b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
5. Seismic Restraint Systems:
   a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
   b. Install restraints within permissible angles in accordance with seismic design.
   c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
   d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
   e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.04 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.

B. Inspect seismic control components for damage and defects.

C. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.

D. Vibration Isolation Systems:

1. Verify isolator static deflections.

2. Verify required clearance beneath vibration-isolated equipment support bases.
3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

E. Seismic Controls:
1. Verify snubbing element air gaps.

F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

DIVISION 23 05 10 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.
B. Tags.
C. Stencils.
D. Pipe markers.
E. Ceiling tacks.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
D. Product Data: Provide manufacturers catalog literature for each product required.
E. Samples: Submit two labels for each proposed.
F. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
G. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.
B. Air Terminal Units: Tags.
C. Automatic Controls: Tags. Key to control schematic.
D. Control Panels: Nameplates.
E. Dampers: Ceiling tacks, where located above lay-in ceiling.
F. Ductwork: Nameplates.
G. Heat Transfer Equipment: Nameplates.
H. Instrumentation: Tags.
I. Major Control Components: Nameplates.
J. Piping: Tags.
K. Pumps: Nameplates.
L. Relays: Tags.
M. Small-sized Equipment: Tags.
N. Tanks: Nameplates.
O. Thermostats: Nameplates.
P. Valves: Tags and ceiling tacks where located above lay-in ceiling.
Q. Water Treatment Devices: Nameplates.

2.02 NAMEPLATES

A. Manufacturers:
1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
2. Brady Corporation: www.bradycorp.com.
3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
4. Seton Identification Products: www.seton.com.
5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Letter Color: White.
C. Letter Height: 1/4 inch (6 mm).
D. Background Color: Black.
E. Plastic: Comply with ASTM D709.

2.03 TAGS

A. Manufacturers:
1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
2. Brady Corporation: www.bradycorp.com.
3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
4. Seton Identification Products: www.seton.com.
5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2-inch (40 mm) diameter.
C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2-inch (40 mm) diameter with smooth edges.
D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

A. Manufacturers:
1. Brady Corporation: www.bradycorp.com.
2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
3. Seton Identification Products, a Tricor Company: www.seton.com.
4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Stencils: With clean cut symbols and letters of following size:
1. 3/4 to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.
4. 8 to 10 inch (200-250 mm) Outside Diameter of Insulation or Pipe: 24 inch (600 mm) long color field, 2-1/2 inch (65 mm) high letters.
5. Over 10 inch (250 mm) Outside Diameter of Insulation or Pipe: 32 inch (800 mm) long color field, 3-1/2 inch (90 mm) high letters.
6. Ductwork and Equipment: 2-1/2 inch (65 mm) high letters.

2.05 PIPE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradycorp.com.
2. MIFAB, Inc.: www.mifab.com.
3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
4. Seton Identification Products, a Tricor Company: www.seton.com.
5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Color: Comply with ASME A13.1.
C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.
F. Color code as follows:
1. Heating, Cooling, and Boiler Feedwater: Green with white letters.
2. Toxic and Corrosive Fluids: Orange with black letters.
3. Compressed Air: Blue with white letters.

2.06 CEILING TACKS

A. Manufacturers:
   1. Craftmark: www.craftmarkid.com.
   2. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Description: Steel with 3/4-inch (20 mm) diameter color coded head.
C. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.
   3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
B. Install tags with corrosion resistant chain.
C. Install plastic pipe markers in accordance with manufacturer's instructions.
D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
E. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
F. Use tags on piping 3/4-inch (20 mm) diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
G. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
H. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

DIVISION 23 05 12 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of mechanical systems.
B. Measurement of final operating condition of HVAC systems.
C. Sound measurement of equipment operating conditions.
D. Vibration measurement of equipment operating conditions.
E. Commissioning activities.

1.02 RELATED REQUIREMENTS

A. *Division 01 22 00* - Allowances: Inspection and testing allowances.
B. *Division 01 40 00* - Quality Requirements: Employment of testing agency and payment for services.
C. *Division 01 90 00* - General Commissioning Requirements: Commissioning requirements that apply to all types of work.

1.03 PRICE AND PAYMENT PROCEDURES

A. Cash Allowance: See *Division 01 23 00* for additional requirements.
B. Allowance includes testing, adjusting, and balancing of mechanical systems.

1.04 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).
C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; 2005, Seventh Edition.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2023.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit to Architect.
   2. Submit to the Commissioning Authority.
   3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
   4. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
   5. Include at least the following in the plan:
      a. Preface: An explanation of the intended use of the control system.
      b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      d. Identification and types of measurement instruments to be used and their most recent calibration date.
      e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      f. Final test report forms to be used.
      g. Detailed step-by-step procedures for TAB work for each system and issue, including:
         1) Terminal flow calibration (for each terminal type).
         2) Diffuser proportioning.
         3) Branch/submain proportioning.
         4) Total flow calculations.
         5) Rechecking.
         6) Diversity issues.
      h. Expected problems and solutions, etc.
      i. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
      j. Details of how TOTAL flow will be determined; for example:
         1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
      k. Confirmation of understanding of the outside air ventilation criteria under all conditions.
      l. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
      m. Method of checking building static and exhaust fan and/or relief damper capacity.
      n. Proposed selection points for sound measurements and sound measurement methods.
      o. Methods for making coil or other system plant capacity measurements, if specified.
      p. Time schedule for TAB work to be done in phases (by floor, etc.).
      q. Description of TAB work for areas to be built out later, if any.
      r. Time schedule for deferred or seasonal TAB work, if specified.
      s. False loading of systems to complete TAB work, if specified.
      t. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
      u. Interstitial cavity differential pressure measurements and calculations, if specified.
      v. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
      w. Procedures for formal progress reports, including scope and frequency.

x. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Field Logs: Submit at least twice a week to the Commissioning Authority.

E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

F. Progress Reports.

G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Submit under provisions of Section 01 4000.
   2. Submit to the Commissioning Authority within two weeks after completion of testing, adjusting, and balancing.
   3. Revise TAB plan to reflect actual procedures and submit as part of final report.
   4. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
   5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
   6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
   7. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
   8. Include the following on the title page of each report:
      a. Name of Testing, Adjusting, and Balancing Agency.
      b. Address of Testing, Adjusting, and Balancing Agency.
      c. Telephone number of Testing, Adjusting, and Balancing Agency.
      d. Project name.
      e. Project location.
      f. Project Architect.
      g. Project Engineer.
      h. Project Contractor.
      i. Project altitude.
      j. Report date.

H. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
   1. AABC (NSTSB), AABC National Standards for Total System Balance.
   2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
   3. SMACNA (TAB).
   4. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Having minimum of three years' documented experience.
   3. Certified by one of the following:
      a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit

AABC National Performance Guaranty.
b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.
F. TAB Supervisor Qualifications: Professional Engineer licensed in the State in which the Project is located.
G. Pre-Qualified TAB Agencies:
1. Substitutions: See *Division 01 60 00* - Product Requirements.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed completely and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.
C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.
B. Ensure recorded data represents actual measured or observed conditions.
C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 COMMISSIONING

A. See *Division 01 90 00* - General Commissioning Requirements and *23 08 00* for additional requirements.
B. Perform prerequisites prior to starting commissioning activities.
C. Fill out Pre-functional Checklists for:
   1. Air side systems.
D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
E. Re-check minimum outdoor air intake flows, and maximum and intermediate total airflow rates as directed by Commissioning Authority.
   1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
   2. Use the same test instruments as used in the original TAB work.
   3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
   4. For purposes of re-check, failure is defined as follows:
      a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
      b. Minimum Outside Air Flow: Deviation of more than 10 percent of instrument reading;
      c. Temperatures: Deviation of more than one degree F (0.5 degree C).
      d. Air Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
      e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
   5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
F. In the presence of the Commissioning Authority, verify that:
   1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
   2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
   3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.07 SCOPE

A. Test, adjust, and balance the following:
   1. Air Cooled Refrigerant Condensers.
   2. Packaged Roof Top Heating/Cooling Units.
   3. Packaged Terminal Air Conditioning Units.
   4. Unit Air Conditioners.
   5. Air Handling Units.
   6. Fans.
   7. Air Filters.
   8. Air Terminal Units.
   9. Air Inlets and Outlets.

3.08 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
   1. Manufacturer.
   2. Model/Frame.
   3. HP/BHP.
   4. Phase, voltage, amperage; nameplate, actual, no load.
   5. RPM.
   6. Service factor.
   7. Starter size, rating, heater elements.
   8. Sheave Make/Size/Bore.

B. V-Belt Drives:
   1. Identification/location.
   2. Required driven RPM.
   3. Driven sheave, diameter and RPM.
   4. Belt, size and quantity.
   5. Motor sheave diameter and RPM.
   6. Center to center distance, maximum, minimum, and actual.

C. Air Cooled Condensers:
   1. Identification/number.
   2. Location.
   3. Manufacturer.
   4. Model number.
   5. Serial number.
   6. Entering DB air temperature, design and actual.
   7. Leaving DB air temperature, design and actual.
   8. Number of compressors.

D. Air Moving Equipment:
   1. Location.
   2. Manufacturer.
   3. Model number.
   4. Serial number.
   5. Arrangement/Class/Discharge.
   6. Air flow, specified and actual.
   7. Return air flow, specified and actual.
   8. Outside air flow, specified and actual.
   9. Total static pressure (total external), specified and actual.
   10. Inlet pressure.
   11. Discharge pressure.
   12. Sheave Make/Size/Bore.
   13. Number of Belts/Make/Size.
   14. Fan RPM.

E. Return Air/Outside Air:
   1. Identification/location.
   2. Design air flow.
   3. Actual air flow.
   4. Design return air flow.
   5. Actual return air flow.
   6. Design outside air flow.
   7. Actual outside air flow.
   8. Return air temperature.
   9. Outside air temperature.
   10. Required mixed air temperature.
   11. Actual mixed air temperature.
   12. Design outside/return air ratio.
   13. Actual outside/return air ratio.

F. Exhaust Fans:
    1. Location.
    2. Manufacturer.
    3. Model number.
    4. Serial number.
    5. Air flow, specified and actual.
    6. Total static pressure (total external), specified and actual.
    7. Inlet pressure.
    8. Discharge pressure.
    9. Sheave Make/Size/Bore.
    10. Number of Belts/Make/Size.
    11. Fan RPM.
G. Duct Traverses:
    1. System zone/branch.
    2. Duct size.
    3. Area.
    4. Design velocity.
    5. Design air flow.
    6. Test velocity.
    7. Test air flow.
    8. Duct static pressure.
    9. Air temperature.
    10. Air correction factor.
H. Duct Leak Tests:
    1. Description of ductwork under test.
    2. Duct design operating pressure.
    3. Duct design test static pressure.
    4. Duct capacity, air flow.
    5. Maximum allowable leakage duct capacity times leak factor.
    6. Test apparatus:
        a. Blower.
        b. Orifice, tube size.
        c. Orifice size.
        d. Calibrated.
    7. Test static pressure.
    8. Test orifice differential pressure.
    9. Leakage.
I. Air Monitoring Stations:
    1. Identification/location.
    2. System.
    3. Size.
    4. Area.
    5. Design velocity.
    6. Design air flow.
    7. Test velocity.
    8. Test air flow.
J. Terminal Unit Data:
    1. Manufacturer.
    2. Type, constant, variable, single, dual duct.
    3. Identification/number.
    4. Location.
    5. Model number.
    6. Size.
    7. Minimum static pressure.
    8. Minimum design air flow.
    9. Maximum design air flow.

10. Maximum actual air flow.
11. Inlet static pressure.

K. Air Distribution Tests:
1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Area factor.
6. Design velocity.
7. Design air flow.
8. Test (final) velocity.
9. Test (final) air flow.
10. Percent of design air flow.

L. Sound Level Reports:
1. Location.
2. Octave bands - equipment off.
3. Octave bands - equipment on.

M. Vibration Tests:
1. Location of points:
   a. Fan bearing, drive end.
   b. Fan bearing, opposite end.
   c. Motor bearing, center (if applicable).
   d. Motor bearing, drive end.
   e. Motor bearing, opposite end.
   f. Casing (bottom or top).
   g. Casing (side).
   h. Duct after flexible connection (discharge).
   i. Duct after flexible connection (suction).
2. Test readings:
   a. Horizontal, velocity and displacement.
   b. Vertical, velocity and displacement.
   c. Axial, velocity and displacement.
3. Normally acceptable readings, velocity and acceleration.
4. Unusual conditions at time of test.
5. Vibration source (if non-complying).

DIVISION 23 05 14 - DIFFUSERS AND GRILLES

GENERAL

A complete system of ceiling and sidewall diffusers and grilles for supply, return and exhaust air shall be provided throughout the building.

Perforated diffusers shall not be permitted.

The diffusers and grilles shall be constructed of steel with powdered coated surfaces. Aluminum diffusers and grilles shall be specified for moist and humid locations.

In general, provide 4-way adjustable stamped louver faced diffusers and double deflection registers.

Provide opposed blade dampers in all diffusers and registers. Designers shall show location of all balancing dampers on plans.

DIVISION 23 07 13 - DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.
B. Duct liner.
C. Insulation jackets.

1.02 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
E. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
C. Samples: Submit two samples of any representative size illustrating each insulation type.
D. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Johns Manville: www.jm.com.
   3. Knauf Insulation: www.knaufinsulation.com/#sle.

4. Owens Corning Corporation: www.ocbuildingspec.com.
5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

C. Vapor Barrier Tape:
1. Manufacturers:
a. Substitutions: See *Division 01 60 00* - Product Requirements
2. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.

D. Outdoor Vapor Barrier Mastic:
1. Manufacturers:
a. Substitutions: See *Division 01 60 00* - Product Requirements
2. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

E. Tie Wire: Annealed steel, 16-gauge, 0.0508-inch diameter (1.29 mm diameter).

2.03 GLASS FIBER, RIGID

A. Manufacturer:
1. CertainTeed Corporation: www.certainteed.com/#sle.
2. Johns Manville: www.jm.com.
3. Knauf Insulation: www.knaufinsulation.com/#sle.
4. Owens Corning Corporation: www.ocbuildingspec.com.
5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Insulation: ASTM C612; rigid, noncombustible blanket.
1. K (Ksi) Value: 0.24 at 75 degrees F (0.036 at 24 degrees C), when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 450 degrees F (232 degrees C).
3. Maximum Water Vapor Absorption: 5.0 percent.
4. Maximum Density: 8.0 lb/cu ft (128 kg/cu m).

C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.

E. Indoor Vapor Barrier Finish:
1. Manufacturers:
a. Substitutions: See *Division 01 60 00* - Product Requirements
2. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight, glass fabric.
3. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.04 JACKETS

A. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
1. Lagging Adhesive.
a. Compatible with insulation.

B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square (2.45 kg/sq m).

C. Aluminum Jacket: ASTM B209 (ASTM B209M).
1. Thickness: 0.016-inch (0.40 mm) sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2-inch (50 mm) laps.
4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory-attached protective liner.

5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.
6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

2.05 DUCT LINER

A. Manufacturers:
1. CertainTeed Corporation: www.certainteed.com/#sle.
2. Johns Manville: www.jm.com.
3. Knauf Insulation: www.knaufinsulation.com/#sle.
4. Owens Corning Corporation: www.ocbuildingspec.com.
5. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
1. Fungal Resistance: No growth when tested according to ASTM G21.
2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F (0.045 at 24 degrees C).
3. Service Temperature: Up to 250 degrees F (121 degrees C).
4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm (25.4 m/s), minimum.
5. Minimum Noise Reduction Coefficients:
   a. 1/2-inch (13 mm) Thickness: 0.30.
   b. 1 inch (25 mm) Thickness: 0.45.
   c. 1-1/2 inches (40 mm) Thickness: 0.60.
   d. 2-inch (50 mm) Thickness: 0.70.

C. Adhesive: Waterproof, fire-retardant type, ASTM C916.

D. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Supply duct shall be externally insulated.

D. Return duct shall be internally insulated.

E. Insulated Ducts Conveying Air Below Ambient Temperature:
1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

F. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor) (below 3 meters above finished floor): Finish with canvas jacket sized for finish painting.

G. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with outdoor jacket finished as specified in *Division 09 90 00*.

H. External Duct Insulation Application:
1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

I. Duct and Plenum Liner Application:
1. Adhere insulation with adhesive for 90 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.

3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.03 SCHEDULES

A. Combustion Air Duct:
1. Flexible Glass Fiber Duct Insulation: 2 inches thick.
2. Rigid Glass Fiber Duct Insulation: 2 inches thick.
3. Flexible Glass Fiber Duct Liner Insulation: 1-1/2 inches thick.
4. Rigid Glass Fiber Duct Liner Insulation: 1-1/2 inches thick.

DIVISION 23 08 00 - COMMISSIONING OF HVAC SYSTEMS

PART 1 GENERAL – 100% Commissioning required.

1.01 SUMMARY

A. The work under this Section is subject to requirements of the Contract Documents including the Owner's General Conditions and articles of the Construction Manager's General Conditions.
B. General commissioning requirements are detailed in *Division 01*.
C. The commissioning process does not reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product in accordance with the Contract Documents.
D. This section shall in no way diminish the responsibility of the *Division 23* Contractors, Subs and Suppliers in performing all aspects of work and testing as outlined in the contract documents. Any requirements outlined in this section are in addition to requirements outlined in *Division 01* and *23 Specifications*.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
B. The requirements in this section are in addition to those specifically outlined in:
1. *Division 01 80 00* – Minimum Owner Training Requirements
2. *Division 01 90 00* – General Commissioning Requirements

1.03 HVAC EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

A. The following equipment and systems shall be commissioned as part of this project. All general references to equipment and systems within this document refer only to those identified below:
1. Rooftop Units
2. Dedicated Outside Air Units
3. Makeup Air Units
4. Exhaust Fans
5. VAV Terminal Units
6. Ductless Mini Split Units
7. Electric Unit Heaters
8. Building Automation and Control Systems

1.04 REFERENCES

A. Refer to *Division 01 90 00* for applicable references for work associated with this section.

1.05 DEFINITIONS & ABBREVIATIONS

A. Refer to *Division 01 90 00* for definitions and abbreviations for terms in this section.

1.06 COMMISSIONING TEAM

A. Refer to Section 01 9113 for commissioning team members.

1.07 COMMISSIONING SUBMITTALS

A. Refer to *Division 01 90 00* for additional information regarding commissioning submittals.
B. TAB Plan
1. The GC/CM, with assistance from the TABC, shall develop a TAB Plan and execute TAB utilizing the following procedure.
2. Compile detailed TAB forms according to the TABC's certifying agency standard. TAB documentation shall include specific boxes or lines for recording and documenting data of each piece of equipment.

3. Submit the TAB Plan to the CxA for review and include the following at a minimum:
    a. Table of Contents.
    b. Detailed description of how TAB will be completed. Specifically, the TAB Plan shall identify any diversity in system designs and how the TAB process will account for this.
    c. Schedule of TAB activities by equipment (initial TAB Plan submittal schedule shall be tentative; TAB schedule shall be updated as construction proceeds and forwarded to CxA).
    d. Separate tagged divider by system and equipment with TAB forms and documentation.
4. The CxA, A/E and OR reviews the TAB Plan for content and format. The CxA shall return the TAB Plan with comments to GC/CM and the GC/CM shall revise the TAB Plan based on CxA comments.
5. The GC/CM shall forward copies of the completed TAB Plan to CxA, A/E and OR for review. Any comments that require re-TAB are the responsibility of the GC/CM until results are acceptable.
6. After the completed TAB Plan is approved, the CxA will execute on-site verification of selected readings reported in the TAB Plan. The TABC must supply the technician who performed the measurements and the equipment used for verification.
7. Once all TAB activities are complete, the GC/CM shall submit a complete, compiled TAB Plan for review documentation. Any comments made by the CxA shall be incorporated.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Refer to *Division 01 90 00* for additional test equipment requirements.

B. If not otherwise specified, the following minimum requirements apply.
    1. Temperature sensors and digital thermometers shall have a certified accuracy of 0.5°F and a resolution of ±0.1°F.
    2. Pressure sensors shall have an accuracy of ±2.0% of the value range being measured (not full range of meter).

PART 3 EXECUTION

3.01 COMMISSIONING PROCESS OVERVIEW

A. Refer to *Division 01 90 00* for an overview of the commissioning process.

3.02 ROLES AND RESPONSIBILITIES

A. Refer to *Division 01 90 00* for roles and responsibilities of additional team members.

B. Controls Contractor Responsibilities
    1. Include costs for all commissioning requirements in contract price.
    2. Review and provide feedback on the FPT test procedures developed by the CxA.
        a. Ensure all test procedures are executable with the control system as programmed. This includes overriding all points as indicated.
        b. Verify all graphics, trend logs and alarms are programed and active as indicated in the contract documents and FPT test procedures.
    3. Any tasks indicated within the FPT scripts do not override any other start-up and checkout tasks identified in Division 23. It is the CC responsibility to ensure the system is fully operational and operating in automatic mode prior to execution of FPTs.
    4. Provide trained and certified technician familiar with the project programming to execute the FPT test procedures at the direction of the CxA.

C. TAB Contractor Responsibilities
    1. Include costs for all commissioning requirements in contract price.
    2. Develop the TAB Plan in coordination with the GC/CM.
    3. Make revisions to TAB work as identified by the CxA, A/E and/or OR for conformance with the contract documents.

3.03 SCHEDULING AND COORDINATION

A. Refer to *Division 01 90 00* for scheduling and coordination requirements.

3.04 PRE-FUNCTIONAL CHECKLISTS

A. Refer to *Division 01 90 00* for PFC requirements.

3.05 START-UP AND INITIAL CHECKOUT

A. Refer to *Division 01 90 00* for Start-Up and Checkout requirements.

3.06 TESTING, ADJUSTING AND BALANCING

A. The GC/CM shall develop the TAB Plan and submit to the CxA, A/E, and OR for approval a minimum of thirty (30) days prior to the anticipated start of TAB activities.

B. After receiving approval of the TAB Plan, the GC/CM shall organize and lead a TAB Coordination Meeting. All CT members shall attend and provide feedback on TAB activities.

C. The TABC shall execute TAB activities per the TAB Plan.

D. Once the completed TAB Plan has been reviewed, the CxA will conduct on-site TAB verification.

1. TABC shall supply the technician(s) who took the original readings and the equipment used as reported in the completed TAB Plan.
2. The CxA will identify a sample of readings that the TABC shall reproduce. The CxA shall confirm that the equipment and techniques used to gather the measurements are correct and the readings are accurate.
3. Any discrepancies identified will be identified as Cx Issues and tracked on the Cx Issues Log.
   a. If issues are limited or minor in nature, the CxA will recommend only the identified issues be remedied.
   b. If issues are numerous or the CxA that identified issues are systemic, the CxA will reject the completed TAB Plan and require the process to be repeated.

E. The GC/CM shall notify the CxA of any changes to the TAB schedules that will affect commissioning activities. The CxA will work with the GC/CM and TABC to schedule new dates as necessary. The GC/CM shall notify the CxA a minimum of five (5) days in advance of scheduled commissioning visits if re-scheduling is required.

1. Any time for the CxA to visit the site to execute commissioning tasks on equipment or systems that were identified as being ready by the GC/CM but found to not be, will be back charged to the GC/CM at a cost of $2,500 plus expenses per man-day.

F. The GC/CM shall provide the CxA with signed and dated copy of completed TAB Plan documents prior to scheduling of FPTs. Only individuals having direct knowledge that a line item task was actually performed shall complete the documentation.

G. The TABC shall clearly list outstanding items or initial TAB tasks that are not completed successfully. Completed forms documenting any outstanding deficiencies shall be provided to CxA within two (2) working days of completion.

3.07 FUNCTIONAL PERFORMANCE TESTS

A. Refer to *Division 01 90 00* for FPT requirements.

3.08 NON-CONFORMANCE AND COMMISSIONING ISSUES

A. Refer to *Division 01 90 00* for information regarding Non-Conformance and Cx Issues.

3.09 OWNER TRAINING

A. The GC/CM is responsible for execution of Owner Training as outlined in *Division 01 80 00*.

DIVISION 23 09 23 - DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. UL (DIR) - Online Certifications Directory; Current Edition.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for each system component and software module.

C. Shop Drawings:

1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
2. List connected data points, including connected control unit and input device.

3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
5. Indicate description and sequence of operation of operating, user, and application software.

D. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.

E. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
1. Revise shop drawings to reflect actual installation and operating sequences.
2. Include submittals data in final "Record Documents" form.

F. Operation and Maintenance Data:
1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

H. Maintenance Materials:
1. See *Division 01 60 00* - Product Requirements, for additional provisions.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 70.

B. Designer Qualifications: Perform design of system using manufacturer's software under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

D. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.

E. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.05 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five-year period after Substantial Completion.

C. Provide five-year manufacturer's warranty for field programmable micro-processor based units.

1.06 PROTECTION OF SOFTWARE RIGHTS

A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
1. Limiting use of software to equipment provided under these specifications.
2. Limiting copying.
3. Preserving confidentiality.
4. Prohibiting transfer to a third party.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Honeywell International, Inc: www.honeywell.com.

B. Johnson Controls, Inc: www.johnsoncontrols.com.

C. Siemens AG, Building Technologies Division: www.siemens.com.

D. Substitutions: See *Division 01 60 00* - Product Requirements.

PART 3 EXECUTION

3.01 INSTALLERS

A. Installer List:

B. Substitution Limitations: Same as specified for products; see *Division 01 60 00* - Product Requirements.

3.02 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that conditioned power supply is available to the control units and to the operator workstation. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.03 INSTALLATION

A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
B. Install software in control units and in operator workstations. Implement all features of programs to specified requirements and appropriate to sequence of operation.
C. Provide with 120v AC, 15 amp dedicated emergency power circuit to each programmable control unit.
D. Provide conduit and electrical wiring. Electrical material and installation shall be in accordance with appropriate requirements of *Division 26*.

3.04 MANUFACTURERS' FIELD SERVICES

A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3-day period.
C. Provide basic operator training on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time. Provide training on site.

3.05 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate complete and operating system to Owner.

3.06 MAINTENANCE

A. Provide service and maintenance of energy management and control systems for one year from Date of Substantial Completion.
B. Provide two complete inspections, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.
C. Provide complete service of systems, including call backs.

DIVISION 23 11 23 - NATURAL GAS SYSTEMS

PART 1 GENERAL

Engineer and Contractor -MSCS will coordinate with the natural gas utility and have the gas line routed to the gas meter, MSCS will pay any cost incurred. The plumbing contractor shall connect to the load side of the meter and extend inside the building.

Provide main gas valves above ground and prior to entrance into building. Use ball valves on all gas lines inside the buildings.

Gas piping may be installed above the accessible (lay-in) ceiling and as dictated by the current adopted building code. Do not locate gas piping under a floor slab on grade or inside solid partitions including CMU.

Provide accessible chases for concealed gas piping (i.e. access panels).

Floor trenches are not allowed.

Provide gas shut-off valves for each piece of equipment.

Provide an emergency one button operation gas shut-off valve in science rooms. Mount the valve box near the teacher demonstration table.

Final connections to equipment shall be made with flexible connectors. Provide 6" dirt leg at each vertical rise and prior to each equipment connection.

Each gas fueled HVAC appliance/ equipment shall have an individual gas regulator.

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.02 RELATED REQUIREMENTS

A. *Division 08 31 00* - Access Doors and Panels.
B. *Division 23 05 00* - Vibration and Seismic Controls for HVAC.
C. *Division 23 05 10* - Identification for HVAC Piping and Equipment.

1.03 REFERENCE STANDARDS

A. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators; 2007 (Reaffirmed 2012).
B. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators; 2011 (Including Addendum 1).
C. ANSI Z223.1 - National Fuel Gas Code; 2015.
D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
E. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
F. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2013.
G. ASME B31.1 - Power Piping; 2014.
H. ASME B31.9 - Building Services Piping; 2014.
I. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).
J. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
K. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
L. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2015.
M. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
O. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2010.
P. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2002 (Reapproved 2010).
Q. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2014.
R. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2014.
S. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.
T. AWWA C606 - Grooved and Shouldered Joints; 2011.
U. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2012.
V. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.
W. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2013.
X. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2013.
Y. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 2011.
Z. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers' catalog information. Indicate valve data and ratings.
C. Welder Certificate: Include welders' certification of compliance with ASME BPVC-IX.
D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
E. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.
B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
E. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
B. Provide temporary protective coating on cast iron and steel valves.
C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
   1. Fittings: ASTM A234/A234M, wrought steel welding type.
   2. Joints: ANSI Z223.1, welded.
   3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

2.02 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to ASME B31.1.

2.03 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches (80 mm) and Under:
   1. Ferrous Pipe: Class 150 malleable iron threaded unions.
B. Flanges for Pipe Size Over 1 Inch (25 mm):
   1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.04 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
   4. Vertical Pipe Support: Steel riser clamp.
   5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
   6. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
      a. Bases: High density polypropylene.
      b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
      c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
      d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
      e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.
      f. Manufacturers:
         1) PHP Systems/Design: www.phpsd.com/#sle.
         2) Substitutions: See *Division 01 60 00* - Product Requirements.

B. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
   5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
   6. Other Types: As required.
   7. Manufacturers:
      a. Powers Fasteners, Inc: www.powers.com/#sle.
      b. Substitutions: See *Division 01 60 00* - Product Requirements.

2.05 BALL VALVES

A. Manufacturers:
   1. Apollo Valves: www.apollovalves.com/#sle.
   2. Grinnell Products: www.grinnell.com/#sle.
   3. Nibco, Inc: www.nibco.com/#sle.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder, threaded, or grooved ends with union.

2.06 PLUG VALVES

A. Manufacturers:
   1. Flowserve Corporation: www.flowserve.com.
   2. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Construction 2-1/2 Inches (65 mm) and Larger: MSS SP-78, 175 psi (1200 kPa) CWP, cast iron body and plug, pressure lubricated, Teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

2.07 STRAINERS

A. Manufacturers:
   1. Armstrong International, Inc: www.armstronginternational.com/#sle.
   2. Green Country Filter Manufacturing: www.greencountryfilter.com/#sle.
   3. WEAMCO: www.weamco.com/#sle.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Size 2 inch (50 mm) and Under:
   1. Threaded brass body for 175 psi (1200 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
   2. Class 150, threaded bronze body 300 psi (2070 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.

C. Size 1-1/2 inch (40 mm) to 4 inch (100 mm):
   1. Class 125, flanged iron body, Y pattern with 1/16 inch (1.6 mm) stainless steel perforated screen.

D. Size 5 inches (125 mm) and Larger:
   1. Class 125, flanged iron body, basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.

2.08 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

A. Manufacturers:
   1. Actaris Metering Systems (A brand of ITT Controls): www.actaris-metering-systems.com/#sle.
   2. Dungs Combustion Controls: www.dungs.com/#sle.
   3. Maxitrol Company: www.maxitrol.com/#sle.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Compliance Requirements:
   1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
   2. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.

C. Materials in Contact With Gas:
   1. Housing: Aluminum, steel (free of non-ferrous metals).

2. Seals and Diaphragms: NBR-based rubber.

D. Maximum Inlet Operating Pressure: 10 psi (68.9 kPa).
   1. Appliance Regulator: 10 psi (68.9 kPa).
   2. Line Pressure Regulator: 10 psi (68.9 kPa).

E. Maximum Body Pressure: 10 psi (1000 mbar).

F. Output Pressure Range: 1-inch wc (2.5 mbar) to 80-inch wc (200 mbar).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.
   1. Coordinate size and location of access doors with *Division 08 31 00*.

I. Establish elevations of buried piping outside the building to ensure not less than two feet of cover.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Provide support for utility meters in accordance with requirements of utility companies.

L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

M. Install valves with stems upright or horizontal, not inverted.

N. Pipe vents from gas pressure reducing valves to outdoors and terminate in weatherproof hood.

O. Sleeve pipes passing through partitions, walls and floors.

P. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

Q. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Install hangers to provide minimum 1/2-inch (15 mm) space between finished covering and adjacent work.
   3. Place hangers within 12 inches (300 mm) of each horizontal elbow.
   4. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   7. Provide copper plated hangers and supports for copper piping.
   8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl

spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

9. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to *Division 22 05 48*.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.
B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
C. Install ball valves for shut off and to isolate equipment, part of systems, or vertical risers.
D. Install ball valves for throttling, bypass, or manual flow control services.
E. Provide plug valves in natural gas systems for shut-off service.

3.05 SERVICE CONNECTIONS

A. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 7-inch wg (1.75 kPa). Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

DIVISION 23 21 13 - HVAC PIPING SYSTEMS

GENERAL

All piping systems for HVAC systems in buildings shall be Schedule 40, black steel with either welded, screwed or Victaulic joints except as follows in Products below. Polypropylene heat infused piping shall be considered for schedule and financial impacts on a case-by-case basis. Aquatherm shall be used as a basis of design with this intent and endeavor.

Condensate drains from AHU's and fan coil units shall be type "L" copper. Plastic or PVC drain lines shall not be allowed. Insulate all drain lines. All condensate drains shall be piped to a suitable drain location with cleanout. Provide unions on both sides of the p-trap.

COLD WATER LINES: Cold water lines and chilled water/hot water run outs 1" and smaller, maybe type K copper with soldered joints. Use 95-5 solder.

HOT WATER LINES: Designer shall specify and show on drawings expansion loops on all hot water piping that runs over 200 feet in length.

EXPOSED PIPING: All exposed piping, both insulated and uninsulated, shall be labeled. Exposed un- insulated piping shall also be painted. Paint and color-code all exposed piping system.

UNDERGROUND PIPING: All underground lines should be marked with a bright colored continuous- printed plastic tape on top of the line.
FREEZE PROTECTION: Provide positive freeze protection for all water systems subject to freezing conditions such as air-cooled outdoor chillers, cooling towers, outdoor piping (above ground) etc.

The Engineer shall provide specifications for thoroughly flushing all HVAC piping before placing it in operation. This flushing must be witnessed and verified by the commissioning agent or project engineer (24-hour notice is required). This is especially critical for all hydronic systems. Hydronic systems shall be connected so as to by-pass the units before flushing begins and then flush and clean the filters at least three (3) times before the units are connected to the system and placed in operation. All cooling towers shall be completely cleaned and flushed after all systems are in operation and the sitework has been completed.

Provide bulb wells in central plant piping for electronic sensors. Coordinate with the control system designers for locations of wells. Show detail of wells on drawings.

Provide shut-off valves for all hydronic mains at all take-offs to mechanical rooms and pump rooms. Provide shut-off valves at the supply and return side of all equipment to provide for removal and repair.

Repair any insulation in areas where piping is being replaced or disturbed unless otherwise specified. Provide section on pressure testing of all piping systems.
Insulate all hot water and domestic hot water with 2" thick fiberglass insulation.

Insulate all domestic cold water above ceilings or in exposed mechanical spaces with 2” fiberglass insulation.

All water make-up assemblies shall be provided with a backflow preventer. Provide aluminum jacket on all insulated outdoor piping.

Pipes venting gas from appliances or other devices shall terminate outside the building 2' above any roof line within 10'. Keep away from louvers and overhangs.

All pipe supports have saddles and blocking and all exposed piping, hangers, saddles and supports to be painted with two (2) coats.

All exposed piping in occupied spaces below eight feet to be covered with a 20-gauge metal jacket. Show bypass piping for all heat exchangers.

Show wye strainers in inlet piping to heat exchanger and cooling tower outlet unless strainer is built-in basin. All damper operators, control, and service valves to be installed such that they can be serviced by personnel standing on the floor of the Mechanical Room, if possible.

Designers shall require contractors to dimension actual location of all underground piping on as-built drawings. A minimum of two dimensions from building reference points shall be provided and a bury depth indicated.

DIVISION 23 31 13 – DUCTWORK AND CASINGS

PART 1 GENERAL

All metal ductwork except kitchen hood shall be galvanized sheet metal with zinc coating. Exposed ductwork shall be mill phosphatized for painting.

Use stainless steel (Type 302, 304, or 316) round ductwork with welded joints for the kitchen hood and certain other critical hood exhaust.

Low-pressure ductwork shall be rectangular. Medium and high-pressure ductwork shall be spiral round duct.

Insulate all ductwork, except exposed ductwork, by wrapping it with minimum 1-1/2" thick fiberglass insulation with vapor proof jacket or as required by the energy code. Insulate exposed ductwork by lining with 1" thick fiberglass liner.

Flexible ducts may be used for the above ceiling lay-in system. Use spiral spring steel with flameproof vinyl sheeting, or as allowed by Codes.

Fabric duct systems may not be used.

Seal all ductwork joints with non-hardening mastic or liquid elastic sealant.

1.01 SECTION INCLUDES

A. Metal ductwork.
B. Casing and plenums.
C. Buried ductwork.
D. Kitchen hood ductwork.
E. Duct cleaning.

1.02 RELATED REQUIREMENTS

A. *Division 23 07 13* - Duct Insulation: External insulation and duct liner.

1.03 *REFERENCE STANDARDS*

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2015b.

D. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2016.
E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
I. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
J. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
L. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2012.
M. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.
N. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2013.
O. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2013.
P. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
Q. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
R. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.
S. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
T. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; 2021.
U. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.
V. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.
W. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
X. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.
Y. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for duct materials.
C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for systems.
D. Samples: Submit two samples of typical shop fabricated duct fittings.
E. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meets or exceeds specified requirements.
F. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).
G. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.
H. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meets or exceeds specified requirements.
I. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 3 years of documented experience.

1.06 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.
B. Ducts: Galvanized steel, with zinc coating, unless otherwise indicated.
C. Low Pressure Supply (Heating Systems): 1/2-inch w.g. (125 Pa) pressure class, galvanized steel.
D. Low Pressure Supply (System with Cooling Coils): 1/2-inch w.g. (125 Pa) pressure class, galvanized steel.
E. Buried Supply or Return: 1/2-inch w.g. (125 Pa) pressure class, concrete encased sheet metal.
F. Medium and High-Pressure Supply: 1/2-inch w.g. (125 Pa) pressure class, galvanized steel, sprial round.
G. Return and Relief: 1/2-inch w.g. (125 Pa) pressure class, galvanized steel.
H. General Exhaust: 1/2-inch w.g. (125 Pa) pressure class, galvanized steel.
I. Kitchen Cooking Hood Exhaust: 1/2-inch w.g. (125 Pa) pressure class, galvanized steel.
    1. Construct of 16 gage, 0.0598-inch (1.52 mm) sheet steel using continuous external welded joints in rectangular sections.
    2. Construct of 18 gage, 0.0500 inch (1.27 mm) stainless steel using continuous external welded joints in rectangular sections.
J. Dishwasher Exhaust: 1/2-inch w.g. pressure class, stainless steel (302, 304, or 316).
    1. Construct of 18 gage, 0.0500 inch (1.27 mm) stainless steel using continuous external welded joints in rectangular sections.
K. Grease Exhaust: 1/2-inch w.g. (125 Pa) pressure class, stainless steel.
    1. Construct of 18 gage, 0.0500 inch (1.27 mm) stainless steel.
    2. Construction:
        a. Liquid tight with continuous external weld for all seams and joints.
        b. Where ducts are not self-draining back to equipment, provide low point drain pocket with copper drainpipe to sanitary sewer.
    3. Access Doors:
        a. Provide for duct cleaning inside horizontal duct at drain pockets, every 20 feet (6 m) and at each change of direction.
        b. Use same material and thickness as duct with gaskets and sealants rated 1500 degrees F (815 degrees C) for grease tight construction.
L. Fume Hood Exhaust: 1/2-inch w.g. (125 Pa) pressure class, galvanized steel.
M. Outside Air Intake: 1/2-inch w.g. (125 Pa) pressure class, galvanized steel.
N. Combustion Air: 1/2-inch w.g. (125 Pa) pressure class, galvanized steel.
O. Emergency Generation Ventilation: 1/2-inch w.g. (125 Pa) pressure class, galvanized steel.
P. Transfer Air and Sound Boots: 1/2-inch w.g. (125 Pa) pressure class, fibrous glass.

2.02 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
    1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
    2. VOC Content: Not more than 250 g/L, excluding water.
    3. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
    4. For Use With Flexible Ducts: UL labeled.
    5. Manufacturers:
        a. Carlisle HVAC Products: www.carlislehvac.com/sle.
        b. Substitutions: See *Division 01 60 00* - Product Requirements.

C. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
   5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
   6. Other Types: As required.
   7. Manufacturers:
      a. Powers Fasteners, Inc: www.powers.com.
      b. Substitutions: See *Division 01 60 00* - Product Requirements.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE (FUND) Handbook - Fundamentals.
C. Duct systems have been designed for metal duct. At the Contractor's option, fibrous glass duct may be substituted for metal duct.
D. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
E. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
F. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
G. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
H. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
I. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. Flat Oval Ducts: Machine made from round spiral lockseam duct.
   1. Manufacture in accordance with SMACNA (DCS).
   2. Fittings: Manufacture at least two gages heavier metal than duct.
   3. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
B. Double Wall Insulated Flat Oval Ducts: Machine made from round spiral lockseam duct.
   1. Manufacture in accordance with SMACNA (DCS).
   2. Fittings: Manufacture with solid inner wall.
   3. Inner Wall: Perforated galvanized steel.
   4. Insulation:
      a. Thickness: 1 inch (25 mm) fiberglass.
C. Double Wall Insulated Round Ducts: Round spiral lockseam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with solid inner wall.
   1. Manufacture in accordance with SMACNA (DCS).
   2. Insulation:
      a. Thickness: 1 inch (25 mm).
      b. Material: Air.
D. Flexible Ducts: Multiple layers of aluminum laminate supported by helically wound spring steel wire.
   1. UL labeled.
   2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
   3. Pressure Rating: 10 inches WG (2.50 kPa) positive and 1.0 inches WG (250 Pa) negative.
   4. Maximum Velocity: 4000 fpm (20.3 m/sec).
   5. Temperature Range: Minus 20 degrees F to 210 degrees F (Minus 28 degrees C to 99 degrees C).

6. Manufacturers:
    a. Hart & Cooley, Inc: www.hartandcooley.com.
    b. Substitutions: See *Division 01 60 00* - Product Requirements.

E. Flexible Ducts: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
2. Pressure Rating: 10 inches WG (2.50 kPa) positive and 1.0 inches WG (250 Pa) negative.
3. Maximum Velocity: 4000 fpm (20.3 m/sec).
4. Temperature Range: Minus 20 degrees F to 210 degrees F (Minus 28 degrees C to 99 degrees C).
5. Manufacturers:
    a. Hart & Cooley, Inc: www.hartandcooley.com.
    b. Substitutions: See *Division 01 60 00* - Product Requirements.

2.05 KITCHEN HOOD EXHAUST DUCTWORK

A. Fabricate in accordance with ductwork manufacturer's installation instructions, SMACNA (DCS), SMACNA (KVS), and NFPA 96.

B. Ductwork bearing grease-laden air shall be constructed of and supported by 18-gauge, 304 stainless steel #4 polished finish with continuous external welded liquid tight seams and joints. All exposed ducts shall be stainless steel.

C. Clearance of not less than 18" shall be maintained between hood or duct and combustible materials.

D. Exhaust ducts shall be wrapped in high temperature insulation blanket, which provides a two-hour fire rating around duct with "zero clearance" required from the surface of the insulation (See Section 23 0713 for requirements). Installation and material shall conform to SMACNA (DCS) - Metal and Flexible, NFPA 96 and be UL Listed for this purpose. Install insulation in accordance with manufacturer's recommendations.

E. For exposed kitchen hood exhaust ducts, construct of stainless steel ASTM A167, type 304 using continuous external welded joints.

F. Slope horizontal exhaust ducts back to hood at a 2% slope (8.3% where horizontal duct runs exceed 75 feet) with no trapped low points. Exhaust outlets shall be located minimum 10 feet from an adjacent building or intake opening.

G. Provide access doors to hood damper(s) maximum 18" from damper. Access doors shall be UL listed. Doors shall be accessible without the use of a tool. Label doors "ACCESS PANEL-DO NOT OBSTRUCT".

H. For large exhaust ducts provide 20" X 20" access doors on maximum 20-foot centers for personnel entry to all portions of duct system and at each change in direction. Where entry is not possible due to size, provide minimum 18" X 12" (larger if space permits) hand access doors on maximum 12-foot centers. Doors shall be accessible without the use of a tool. Access doors shall be UL listed. Label doors "ACCESS PANEL-DO NOT OBSTRUCT."

I. Installation shall comply with NFPA 96 and IMC 2003.

J. The HVAC contractor shall prepare and submit shop drawings for approval by the Architect and the authorities having jurisdiction for the entire range hood(s) and ductwork installation indicating compliance with all the above requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install in accordance with manufacturer's instructions.

C. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Buried Supply Duct: Insulate duct runs over 70 feet (20 m) long with 1 inch (25 mm) thick insulation covered with plastic vapor barrier.

E. Buried Metal Ductwork: Paint according to SMACNA (DCS).

F. Buried Metal Ductwork Without Factory Jacket: Paint with one coat and seams and joints with additional coat of asphalt base protective coating.

G. Buried Metal Ductwork: Encase according to SMACNA (DCS).
1. Provide adequate tie-down points to prevent ducts from floating during concrete placement.

2. Introduce no heat into ducts for 20 days following placement of concrete.

H. Flexible Ducts: Connect to metal ducts with adhesive.

I. Kitchen Hood Exhaust: Provide residue traps at base of vertical risers with provisions for clean out.

J. Underground Ducts: Slope to plenums or low pump out points at 1:500. Provide access doors for inspection.

K. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

L. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

M. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

N. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with crimp in direction of air flow.

O. Use double nuts and lock washers on threaded rod supports.

P. Connect terminal units to supply ducts directly or with one foot (300 mm) maximum length of flexible duct. Do not use flexible ducts to change direction.

Q. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.

R. Set plenum doors 6 to 12 inches (150 to 300 mm) above floor. Arrange door swings so that fan static pressure holds doors in closed position.

3.02 CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

B. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

C. Protect ductwork from debris entering ductwork. Inspect ductwork to ensure ductwork is clean. If ductwork is not clean, clean in accordance with paragraphs 3.02 A & B.

PART 4 – GENERAL – UNDERGROUND DUCTWORK

4.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

4.02 SUMMARY

A. Section Includes:
   1. Underground Ducts

4.03 ACTION SUBMITTALS

A. Provide Product Data: For each type of the following products, furnished specialties and accessories.
   1. Underground Ducts
   2. Sealants and Gaskets

B. Shop Drawings: For underground ducts. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Burial and supports, including methods for duct burial and internal and external bracing if recommended by the manufacturer.

4.04 CLOSEOUT SUBMITTALS

A. Installation and Maintenance Data: For underground ducts include installation and maintenance manuals.
   1. Site conditions, excavation and preparation
   2. Instructions for joining ducts
   3. Instructions for proper backfilling and precautions.
   4. Leak testing procedure

4.05 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 5 – PRODUCTS – UNDERGROUND DUCTWORK ACCEPTABLE MANUFACTURERS:

A. The BlueDuct® by AQC Industries, Roseville, MN 55126, (877-783-1520). www.aqcind.com and e-mail: team@aqcind.com

5.01 UNDERGROUND DUCT SYSTEM

A. Complete duct system (including inlet plenums, round duct, run-outs, diffuser boots, etc.) must be from one manufacturer and be of the same material, construction and connection method throughout. Field made duct components are NOT acceptable.
B. Provide elbows, ducts, diffuser boxes, plenums, clamp & gaskets, boots, saddle registers and caulk as required by drawings for underground installation.
C. Unless otherwise noted, all duct and fittings shall be constructed per SMACNA's Duct Construction Standards to withstand +10" w.g. and -2" w.g.
D. Ductwork shall be closed cell plastic material that is recyclable, does not emit volatile organic compounds, and conforms to ASTM-D2412. Ductwork shall be resistant to mildew, mold (UL 181B), and radon gas (BSS 7239-88). Ductwork shall not rust or crack under external stress or strain. Ductwork shall have integral R-10 equivalent thermal insulation value, without the use of external insulation, per NSF's P374 Protocol and verified by a NSF Thermal Testing Report.
E. All joints shall be sealed via gasket or bolts and sealant.
F. Clamps and gaskets shall be used on ductwork without flanges. Clamps shall be polyethylene with stainless steel plates and stainless-steel screws. Gaskets shall comprise of ¼" thick butyl rubber sealant tape that is water and UV resistant and shall not stain. Gaskets shall comply with ASTM-E84 for flame and smoke spread.
G. Flanged joints and duct branches shall use a co-polymer adhesive caulking sealant that is water and UV resistant. Flanges shall be connected with stainless steel bolts.
H. Assembled ductwork shall be able to maintain pressure with no leakage.
I. Duct system shall be installed by an AQC Industries' trained installer.
J. Fiberglass style (FRP) ductwork or PVC coated galvanized steel ductwork shall NOT be acceptable.
K. Duct system performance shall exceed SMACNA's Leakage Class 1 requirements at the system design static pressure.
L. Duct system shall carry a 10-year Limited Warranty.

PART 6 – EXECUTION

A. Installation
    1. Follow The BlueDuct Installation Instructions provided by AQC Industries. It is strongly recommended to complete installation training provided by AQC Industries prior to installation
    2. Excavate a trench evenly as per The Blue Duct Installation Instructions. No bedding is required except for cases of bedrock or clay where sand or light aggregate may be used.
    3. Backfill material must consist of pea gravel or dry silica sand.
    4. The sealant and gasket material provided by AQC Industries must be used as directed. The use of non-approved sealant or gasket will void warranty.
B. Testing
    1. The complete underground duct system shall be tested for leakage after final assembly.
    2. Follow SMACNA air duct leakage test standard.
    3. Allow 24 hours for The BlueDuct sealant to cure after final assembly before testing the duct system. Additional curing time may be required in high ambient conditions.
C. Cleaning
    1. Remove dust and debris from ductwork prior to occupancy.

DIVISION 23 33 00 – AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air turning devices/extractors.
B. Backdraft dampers - metal.
C. Duct access doors.
D. Duct test holes.
E. Fire dampers.
F. Flexible duct connectors.
G. Smoke dampers.
H. Volume control dampers.
I. Miscellaneous products:
    1. Internal strut end plugs.
    2. Duct opening closure film.

1.02 RELATED REQUIREMENTS

A. *Division 22 05 48* - Vibration and Seismic Controls for Plumbing Piping and Equipment.
B. *Division 23 05 00* - Vibration and Seismic Controls for HVAC Piping and Equipment.
C. *Division 23 31 13* - HVAC Ducts and Casings.
D. *Division 23 35 00* - Air Terminal Units: Pressure regulating damper assemblies.

1.03 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
B. NFPA 92 - Standard for Smoke Control Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
F. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
G. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.
D. Manufacturer's Installation Instructions: Provide instructions for fire dampers.
E. Project Record Drawings: Record actual locations of access doors and test holes.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Extra Fusible Links: One of each type and size.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

A. Manufacturers:
    1. Carlisle HVAC Products: www.carlislehvac.com/sle.
    2. Elgen Manufacturing: www.elgenmfg.com.
    3. Krueger: www.krueger-hvac.com.
    4. Ruskin Company: www.ruskin.com.
    5. Titus: www.titus-hvac.com.
    6. Ward Industries by Commercial Products Group of Hart & Cooley, Inc: www.wardind.com.

7. Substitutions: See *01 60 00* - Product Requirements.

B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with push-pull operator strap.

2.02 BACKDRAFT DAMPERS - METAL

A. Manufacturers:
1. Louvers & Dampers, Inc: www.louvers-dampers.com.
2. Nailor Industries Inc: www.nailor.com.
3. Ruskin Company: www.ruskin.com.
4. Substitutions: See *01 60 00* - Product Requirements.

B. Gravity Backdraft Dampers, Size 18 by 18 inches (450 by 450 mm) or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6-inch (150 mm) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to Specifications for varying differential static pressure.

2.03 DUCT ACCESS DOORS

A. Manufacturers:
1. Acudor Products Inc: www.acudor.com.
2. Elgen Manufacturing: www.elgenmfg.com.
3. Nailor Industries Inc: www.nailor.com.
4. Ruskin Company: www.ruskin.com.
5. SEMCO Incorporated: www.semcohvac.com.
6. Ward Industries: www.wardind.com.
7. Substitutions: See *01 60 00* - Product Requirements.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch (25 mm) thick insulation with sheet metal cover.
1. Less Than 12 inches (300 mm) Square: Secure with sash locks.
2. Up to 18 inches (450 mm) Square: Provide two hinges and two sash locks.
3. Up to 24 by 48 inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
4. Larger Sizes: Provide an additional hinge.

D. Access doors with sheet metal screw fasteners are not acceptable.

2.04 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
1. Manufacturers:
Carlisle HVAC Products: www.carlislehvac.com/sle.
2. Substitutions: See *01 60 00* - Product Requirements.

2.05 FIRE DAMPERS

A. Manufacturers:
1. Louvers & Dampers, Inc: www.louvers-dampers.com.
2. Nailor Industries Inc: www.nailor.com.
3. Ruskin Company: www.ruskin.com.
4. Ward Industries: www.wardind.com.
5. Substitutions: See *01 60 00* - Product Requirements.

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

C. Ceiling Dampers: Galvanized steel, 22 gage, 0.0299-inch (0.76 mm) frame and 16 gage, 0.0598-inch (1.52 mm) flap, two layers 0.125 inch (3.2 mm) ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.

D. Horizontal Dampers: Galvanized steel, 22-gauge, 0.0299 inch (0.76 mm) frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

E. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel

closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch (250 Pa) pressure class ducts up to 12 inches (300 mm) in height.

F. Multiple Blade Dampers: 16 gage, 0.0598 inch (1.52 mm) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch (3.2 by 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

G. Fusible Links: UL 33, separate at 160 degrees F (71 degrees C) with adjustable link straps for combination fire/balancing dampers.

2.06 FLEXIBLE DUCT CONNECTORS

A. Manufacturers:
   1. Carlisle HVAC Products: www.carlislehvac.com/sle.
   2. Elgen Manufacturing: www.elgenmfg.com.
   3. Substitutions: See *01 60 00* - Product Requirements.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd (1.0 kg/sq m).
      a. Net Fabric Width: Approximately 2 inches (50 mm) wide.
   2. Metal: 3 inches (75 mm) wide, 24 gage, 0.0239 inch (0.61 mm) thick galvanized steel.

D. Leaded Vinyl Sheet: Minimum 0.55 inch (14 mm) thick, 0.87 lbs per sq ft (4.2 kg/sq m), 10 dB attenuation in 10 to 10,000 Hz range.

E. Maximum Installed Length: 14 inches (356 mm).

2.07 SMOKE DAMPERS

A. Manufacturers:
   1. Louvers & Dampers, Inc: www.louvers-dampers.com.
   2. Nailor Industries Inc: www.nailor.com.
   3. Ruskin Company: www.ruskin.com.
   4. Substitutions: See *01 60 00* - Product Requirements.

B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.

C. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by pneumatic actuator.

D. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.

2.08 VOLUME CONTROL DAMPERS

A. Manufacturers:
   1. Louvers & Dampers, Inc: www.louvers-dampers.com.
   2. Nailor Industries Inc: www.nailor.com.
   3. Ruskin Company: www.ruskin.com.
   4. Substitutions: See *01 60 00* - Product Requirements.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Splitter Dampers:
   1. Material: Same gage as duct to 24 inches (600 mm) size in either direction, and two gages heavier for sizes over 24 inches (600 mm).
   2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
   3. Operator: Minimum 1/4-inch (6 mm) diameter rod in self-aligning, universal joint action, flanged bushing with set screw.

D. Single Blade Dampers:
   1. Fabricate for duct sizes up to 6 by 30 inches (150 by 760 mm).
   2. Blade: 24 gage, 0.0239 inch (0.61 mm), minimum.

E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inches (200 by 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
   1. Blade: 18 gage, 0.0478 inch (1.21 mm), minimum.

F. End Bearings: Except in round ducts 12 inches (300 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered

bronze bearings.
1. Manufacturers:
    a. Carlisle HVAC Products: www.carlislehvac.com/sle.
    b. Elgen Manufacturing Company: www.elgenmfg.com.
    c. Substitutions: See *01 60 00* - Product Requirements.

G. Quadrants:
1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
3. Where rod lengths exceed 30 inches (750 mm) provide regulator at both ends.
4. Manufacturers:
    a. Carlisle HVAC Products: www.carlislehvac.com/sle.
    b. Substitutions: See Section *01 60 00* - Product Requirements.

2.09 MISCELLANEOUS PRODUCTS

A. Internal Strut End Plugs: Combination end-mounting and sealing plugs for metal conduit used as internal reinforcement struts for metal ducts; plug crimped inside conduit with outside gasketed washer seal.
1. Manufacturers:
    a. Carlisle HVAC Products: www.carlislehvac.com/sle.
    b. Substitutions: See Section *01 60 00* - Product Requirements.

B. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
1. Thickness: 2 mils (0.6 mm).
2. High tack water-based adhesive.
3. UV stable light blue color.
4. Elongation Before Break: 325 percent, minimum.
5. Manufacturers:
    a. Carlisle HVAC Products: www.carlislehvac.com/sle.
    b. Substitutions: See *Division 01 60 00* - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 3100 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8-inch (200 by 200 mm) size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inches (100 by 100 mm) for balancing dampers only. Review locations prior to fabrication.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.

G. Demonstrate re-setting of fire dampers to Owner's representative.

H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

J. For fans developing static pressures of 5.0 inches (1250 Pa) and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.

K. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
L. Use splitter dampers only where indicated.
M. Provide balancing dampers on high velocity systems where indicated. Refer to Section 23 3600 - Air Terminal Units.
N. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

DIVISION 23 34 00 – HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof exhausters.
B. Wall exhausters.
C. Cabinet exhaust fans.
D. Kitchen hood upblast roof exhausters.

1.02 REFERENCE STANDARDS

A. AMCA (DIR) - [Directory of] Products Licensed Under AMCA International Certified Ratings Program; http://www.amca.org/certified/search/company.aspx.
B. AMCA 99 - Standards Handbook; 2016.
C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).
E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.
F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.
G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
I. UL 705 - Power Ventilators; Current Edition, Including All Revisions.
J. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation with size, location and installation of service utilities.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on fans and accessories including fan curves with specified operating points clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
C. Manufacturer's Instructions: Indicate installation instructions.
D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Extra Fan Belts: One set for each individual fan.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS

A. Permanent ventilators may not be used for ventilation during construction.
B. Permanent ventilators may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Greenheck: www.greenheck.com.
B. Loren Cook Company: www.lorencook.com.
C. PennBarry: www.pennbarry.com.

2.02 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.
B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
C. Sound Ratings: AMCA 301, tested to AMCA 300 and bearing AMCA Certified Sound Rating Seal.
D. Fabrication: Comply with AMCA 99.
E. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
G. Enclosed Safety Switches: Comply with NEMA 250.
H. Kitchen Hood Exhaust Fans: Comply with requirements of NFPA 96 and UL 762.

2.03 ROOF EXHAUSTERS

A. Performance Ratings:
    1. Air Flow: Refer to the design schedule.
    2. Static Pressure: Refer to the design schedule.
    3. Fan Tip Speed: Refer to the design schedule.
    4. Fan RPM: Refer to the design schedule.
B. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2-inch (13 mm) mesh, 0.62 inch (1.6 mm) thick aluminum wire bird screen; square base to suit roof curb with continuous curb gaskets.
C. Roof Curb: 8 inch (200 mm) high seismic self-flashing of galvanized steel with continuously welded seams, built-in cant strips.
D. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and wall mounted multiple speed switch.
E. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
F. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.04 WALL EXHAUSTERS

A. Performance Ratings:
    1. Air Flow: Refer to the design schedule.
    2. Static Pressure: Refer to the design schedule.
    3. Fan Tip Speed: Refer to the design schedule
    4. Fan RPM: Refer to the design schedule.
B. Fan Unit: V-belt or direct driven with spun aluminum housing; resiliently mounted motor; 1/2-inch (13 mm) mesh, 0.062 inch (1.6 mm) thick aluminum wire bird screen.
C. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor, and wall mounted multiple speed switch.
D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
E. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.05 CABINET EXHAUST FANS

A. Performance Ratings:
    1. Air Flow: Refer to the design schedule

2. Static Pressure: Refer to the design schedule.
3. Fan RPM: Refer to the design schedule.

B. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.

C. Disconnect Switch: Cord and plug in housing for thermal overload protected motor and wall mounted switch.

D. Grille: Molded white plastic.

E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.06 KITCHEN HOOD UPBLAST ROOF EXHAUSTERS

A. Performance Ratings:
1. Air Flow: Refer to the design schedule.
2. Static Pressure: Refer to the design schedule.
3. Fan Tip Speed: Refer to the design schedule.
4. Fan RPM: Refer to the design schedule.

B. Direct Drive Fan:
1. Fan Wheel:
a. Type: Non-overloading, backward inclined centrifugal.
b. Material: Aluminum.
2. Statically and dynamically balanced.
3. Motors:
a. Open drip-proof (ODP).
b. Heavy duty ball bearing type.
c. Mount on vibration isolators or resilient cradle mounts, out of air stream.
d. Fully accessible for maintenance.
4. Housing:
a. Construct of heavy gage aluminum including curb cap, windband, and motor compartment.
b. Rigid internal support structure.
c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
d. Construct drive frame assembly of heavy gage steel, mounted on vibration isolators.
e. Provide breather tube for fresh air motor cooling and wiring.

C. Shafts and Bearings:
1. Fan Shaft:
a. Ground and polished steel with anti-corrosive coating.
b. First critical speed at least 25 percent over maximum cataloged operating speed.
2. Bearings:
a. Permanently sealed or pillow block type.
b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
c. 100 percent of the factory tested.

D. Drive Assembly:
1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
2. Belts: Static free and oil resistant.
3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
4. Motor pulley adjustable for final system balancing.
5. Readily accessible for maintenance.

E. Disconnect Switches:
1. Factory mounted and wired.
2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
a. Indoor Clean, Dry Locations: Type 1.
b. Outdoor Locations: Type 3R.
3. Finish for Painted Steel Enclosures: Provide manufacturer's standard or factory applied

gray unless otherwise indicated.
4. Positive electrical shutoff.
5. Wired from fan motor to junction box installed within motor compartment.

F. Roof Curb: 8 inch (200 mm) high seismic self-flashing of galvanized steel with continuously welded seams, built-in cant strips, insulation and curb bottom, curb bottom, ventilated double wall, and factory installed nailer strip.
G. Drain Trough: Allows for single-point drainage of water, grease, and other residues.
H. Options/Accessories:
1. Automatic Belt Tensioner: Automatic device that adjusts for correct belt tension for single drives.
2. Birdscreen:
a. Provide galvanized steel construction.
b. Protects fan discharge.
3. Clean Out Port: Removable grease repellent compression rubber plug allows access for cleaning wheel through windband.
4. Roof Curb Extension: Vented curb extension where required for compliance with minimum clearances required by NFPA 96.
5. Dampers: Provide motorized type.
6. Drain Connection:
a. Aluminum construction.
b. Allows single-point drainage of grease, water, or other residues.
7. Finishes: Factory primed.
8. Grease Trap:
a. Aluminum.
b. Includes drain connection.
c. Collects grease residue.
9. Hinge Kit:
a. Aluminum hinges.
b. Hinges and restraint cables mounted to base (sleeve).
c. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.
10. Heat Baffle: Prevents heat from radiating into motor compartments.
11. Tie-down Points: Four brackets located on windband secures fan in heavy wind applications.
12. External motor speed controllers for field mounting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
D. Hung Cabinet Fans:
1. Install fans with resilient mountings and flexible electrical leads. Refer to Section 23 0548.
2. Install flexible connections specified in Section 23 3300 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch (25 mm) flex between ductwork and fan while running.
E. Provide sheaves required for final air balance.
F. Install backdraft dampers on inlet to roof and wall exhausters.
G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

DIVISION 23 35 00 – AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 RELATED REQUIREMENTS

A. *Division 23 05 00* - Vibration and Seismic Controls for HVAC.
B. *Division 23 09 23* - Instrumentation and Control Devices for HVAC: Thermostats and actuators.
C. *Division 23 09 23* - Direct-Digital Control System for HVAC.
D. *Division 23 31 13* - HVAC Ductworks.

E. *Division 23 33 00* - Air Duct Accessories.
F. *Division 23 37 00* - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
B. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).
C. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
D. ASHRAE Std 130 - Methods of Testing Air Terminal Units; 2008 (R2014).
E. ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2013).
F. ASTM A603 - Standard Specification for Zinc-Coated Steel Structural Wire Rope; 1998 (Reapproved 2014).
G. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
I. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
M. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.
N. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
B. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
    1. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 1-to-4-inch wg (250 to 1000 Pa).
C. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.
D. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
E. Project Record Documents: Record actual locations of units and locations of access doors required for access to valving.
F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional provisions.
    2. Extra Motors: One of each type and size.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc.

as suitable for the purpose specified and indicated.

1.07 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.

B. Provide five-year manufacturer warranty for air terminal units.

PART 2 PRODUCTS

2.01 SINGLE-DUCT, VARIABLE-VOLUME AND CONSTANT-VOLUME UNITS

A. Manufacturers:
   1. Johnson Controls, Inc: www.johnsoncontrols.com/#sle.
   2. Trane, a brand of Ingersoll Rand: www.trane.com.
   3. Titus; www.titus-hvac.com.
   4. Price: www.priceindustries.com
   5. Substitutions: See *01 60 00* - Product Requirements.

B. General:
   1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
   2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.

C. Unit Casing:
   1. Minimum 22 gage, 0.0299 inch (0.76 mm) galvanized steel.
   2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
   3. Unit Discharge: Rectangular, with slip-and-drive connections.
   4. Acceptable Liners:
      a. 1/2 inch (13 mm) thick, coated, fibrous-glass complying with ASTM C1071.
         1) Secure with adhesive.
         2) Coat edges exposed to airstream with NFPA 90A approved sealant.
         3) Cover liner with non-porous foil.
      b. 3/4 inch (19 mm) thick polyurethane foam adhesive complying with UL 181 erosion requirements in accordance with ASHRAE Std 62.1 and having a maximum smoke developed index of 50 for both insulation and adhesive, when tested in accordance with ASTM E84.
      c. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.

D. Sound Attenuator:
   1. Provide if required to meet scheduled acoustical performance requirements.
   2. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.
   3. At 2000 fpm (10.16 m/s) inlet velocity, the minimum operating pressure with attenuator added not to exceed 0.14-inch wg (34.84 Pa).

E. Damper Assembly:
   1. Heavy-gage, galvanized steel or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
   2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
   3. Incorporate low leak damper blades for tight airflow shutoff.

F. Electric Heating Coil:
   1. Listed and provided by the terminal unit manufacturer.
   2. Coil Casing: 20 gage, 0.0359 inches (0.92 mm) galvanized steel.
   3. Heating Elements: Nickel chrome, supported by ceramic insulators.
   4. Integral Control Panel: NEMA 250, Type 2 enclosure with hinged access door for access to all controls and safety devices.
   5. Furnish a primary automatic reset thermal cutout and differential pressure airflow switch for proof of airflow.
   6. Provide the following additional components, mounted and/or wired within the control enclosure:

a. Fused or non-fused door interlocking disconnect switch.
b. Mercury contactors.
c. Fuse block.

7. Factory wired, including all limit switches and steps of control as indicated on the equipment schedule, with the SSR (solid-state relay) proportional heat control.

G. Electrical Requirements:
1. Single-point power connection.
2. Equipment wiring to comply with requirements of NFPA 70.

H. Control Transformers: Factory supplied and mounted for electric and electronic control applications.

I. Controls:
1. Electric:
a. Damper Actuator: 24 volts, powered closed, spring return open.
b. Wall-mounted thermostat with Celsius and Fahrenheit display including clock display and set-point of occupied space.
c. See Section 25 3516.
2. Electronic:
a. Damper Actuator: 24-volt, power closed, spring return open.
b. Velocity Controller:
1) Settings for minimum/maximum air volumes, factory-calibrated, and field adjustable at thermostat.
2) Maintain constant airflow dictated by thermostat to within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg (1 kPa), when tested in accordance with ASHRAE Std 130.
3) Provide controller with multi-point with velocity sensors located in air inlets and outlet.
c. Thermostat: Wall-mounted, time-proportional with reheat-coil control including a temperature set-point display in Celsius and Fahrenheit.
d. See Sections 25 1400, 25 3513, and 25 3516.
3. DDC (Direct-Digital Controls):
a. Bi-directional Damper Actuator: 24 volts, powered closed, spring return open.
b. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.
1) Occupied and unoccupied operating mode.
2) Remote reset of temperature or CFM set points.
3) Proportional, plus integral control of room temperature.
4) Monitoring and adjusting with portable terminal.
5) Time-proportional reheat coil control.
c. Room Sensor:
1) Compatible with temperature controls specified.
2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
d. See *Division 25 50 00*.
4. Control Sequence:
a. Suitable for operation with duct pressures between 0.25- and 3.0-inch wg (60 and 750 Pa) inlet static pressure.
b. Include factory-mounted and piped, 5-micron filter; and adjustable, velocity-resetting, high-limit control with amplifying relay.
c. See *Division 23 09 23*.

2.02 AIR TERMINAL UNITS - GENERAL

A. Furnish and install a variable air volume system as herein specified. The system shall be installed in accordance with this specification and the air terminal unit manufacturer's printed recommendations.

B. Unit casing shall be 22 gauge or heavier galvanized steel. Damper blades shall be heavy gage steel with shaft rotating in self-lubricating bearings. Damper shaft shall be marked on end to indicate damper position. Damper blades shall incorporate a flexible gasket for tight airflow

shutoff and shall operate over a full 90 degree rotation. Unit discharge shall be slip and drive construction for field attachment to downstream ductwork.

C. Casing interior shall be lined with minimum ½ in., 2 PCF density, glass fiber insulation with foil facing or metal lining. Insulation edges shall be covered with stitched fiber reinforced foil tape or metal lining. Insulation shall be UL listed and meet NFPA 90A requirements. [All internal linings shall be suitable for cleanroom, hospital, and laboratory applications.]

D. Heating coil exposed tube turns shall be insulated with two-inch duct wrap with foil faced vapor barrier applied to the unit casing with all vapor barrier joints sealed to the unit casing for a sweat free installation. The insulation shall be UL listed and approved for UL standard 181. The insulation shall meet NFPA 90A requirements.
For variable volume terminals, the unit shall modulate from design airflow to scheduled minimum airflow as indicated. The valve shall be capable of a tight shut-off. The average leakage rate across air throttling devices shall not exceed four percent of design air flow at full shut-off, three-inch pressure differential and all box outlets open.

E. An integral flow ring sensor or other averaging type calibration device shall be provided along with unit mounted calibration chart to ensure accuracy of airflow measurement to plus or minus 5% under all types of inlet conditions. Single point sensing tap will NOT be acceptable.

F. Manufacturer must oversize units as required to meet scheduled performance and sound requirements.

G. Furnish factory mounted hot water coil with copper tubes and aluminum fins of capacity scheduled and certified in accordance with AHRI. Exposed tube turns shall be insulated as specified above.

H. Controls shall be of DDC type with pressure independent operation. Hot water valves are specified under the control section of these specifications.

I. The controls contractor shall furnish the DDC controls for the VAV boxes. The controls contractor shall furnish the controller, transformer and electric actuator to the VAV box manufacturer for factory mounting and wiring. All components shall be mounted in a NEMA 1 sheet metal enclosure furnished by the VAV box manufacturer, including a disconnect switch. The price for factory mounting and wiring shall be included in the price of the VAV box manufacturer.

J. The air terminal units shall be physically located in a readily accessible area within the confines of the area controlled by its respective temperature controller (thermostat).

K. Provide adequate space for service and repair of boxes. Coordinate with other divisions of work.

L. Exact location of VAV boxes and all controls including static pressure controls shall be marked on ceiling of facility by tack or other means that shall not overly detract from overall appearance of facility. Additionally, all controls shall be positioned so as to be readily accessible to maintenance personnel upon completion of the project. All static pressure controls shall receive particular attention in this regard.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are suitable for installation.

B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.

C. Provide ceiling access doors or locate units above easily removable ceiling components.

D. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See *Division 23 05 00*.

E. Embed anchors in concrete in accordance with ASTM E488/E488M.

F. Do not support from ductwork.

G. Connect to ductwork in accordance with *Division 23 31 13*.

H. Provide minimum of 5 ft (1.5 m) of 1 inch (25 mm) thick lined ductwork downstream of units.

I. Install heating coils in accordance with manufacturer’s specifications.

J. Verify that electric power is available and of the correct characteristics.

K. Mount all controls located above the ceiling for zone served by each terminal unit on side of VAV

terminal unit or directly adjacent to terminal unit.

3.03 ADJUSTING

A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow. Set units with heating coils for minimum 50 percent full flow.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide manufacturer's field representative to test, inspect, instruct, and observe field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.

1. Leak Test:
   a. After installation, fill water coils and test for leaks.
   b. Repair leaks and retest until no leaks exist.
2. Operational Test:
   a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   b. Test and adjust controls and safeties.
   c. Replace damaged and malfunctioning controls and other equipment.
   d. Remove and replace malfunctioning units and retest as specified above.

3.05 CLEANING

A. Vacuum clean coils and inside of units.

B. Install new filters.

3.06 CLOSEOUT ACTIVITIES

A. See *Division 01 79 00* - Closeout Submittals, for closeout submittals.

B. See *Division 01 80 00* - Demonstration and Training, for additional requirements.

DIVISION 23 36 00 – AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Diffusers.
B. Light troffer diffusers.
C. Registers/grilles.
D. Door grilles.
E. Louvers.
F. Louvered penthouses.
G. Roof hoods.
H. Goosenecks.

1.02 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.
B. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.
C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Samples: Submit two of each required air outlet and inlet type.

D. Project Record Documents: Record actual locations of air outlets and inlets.

1.04 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Test and rate louver performance in accordance with AMCA 500-L.

C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 MOCK-UP

A. Provide mock-up of typical exterior ceiling module with supply and return air outlets.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. American Louver Company: www.americanlouver.com.
B. Hart & Cooley, Inc.: www.hartandcooley.com.
C. Krueger: www.krueger-hvac.com.
D. Price Industries: www.price-hvac.com.
E. Titus: www.titus-hvac.com.
F. Substitutions: See *01 60 00* - Product Requirements.

2.02 ROUND CEILING DIFFUSERS

A. Fabrication: Steel with baked enamel finish.
B. Color: As indicated.
C. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.03 RECTANGULAR CEILING DIFFUSERS

A. Type: Provide square, stamped, multi-core, square, adjustable pattern, stamped, multi-core, square and rectangular, multi-louvered, square and rectangular, adjustable pattern, and multi-louvered diffuser to discharge air in 360-degree, one way, two-way, three-way, and four-way pattern with sectorizing baffles where indicated.
B. Connections: Round.
C. Frame: Provide surface mount, snap-in, inverted T-bar, and spline type. In plaster ceilings, provide plaster frame and ceiling frame.
D. Fabrication: Steel with baked enamel finish.
E. Color: As selected.
F. Accessories: Provide radial opposed blade, butterfly, and combination splitter volume control damper; removable core, sectorizing baffle, safety chain, wire guard, equalizing grid, operating rod extension, anti-smudging device, and gaskets for surface mounted diffusers with damper adjustable from diffuser face.

2.04 CEILING SLOT DIFFUSERS

A. Type: Continuous 1/2 inch (13 mm) wide slot, 1 slots wide, with adjustable vanes for left, right, or vertical discharge; integral ceiling fire damper.
B. Fabrication: Aluminum extrusions with factory clear lacquer finish.
C. Frame: 1-1/4-inch (32 mm) margin with countersunk screw mounting and gasket, mitered end border.
D. Plenum: Integral, galvanized steel, insulated.

2.05 CEILING SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, one-way deflection.
B. Frame: 1-1/4-inch (32 mm) margin with countersunk screw mounting and gasket.
C. Construction: Made of aluminum extrusions with factory enamel finish.
D. Color: As indicated.
E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.06 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with blades set at 45 degrees, vertical face.
B. Frame: 1-1/4-inch (32 mm) margin with countersunk screw mounting.
C. Fabrication: Steel with 20 gage, 0.0359 inch (0.91 mm) minimum frames and 22 gage, 0.0299 inch (0.76 mm) minimum blades, steel and aluminum with 20 gage, 0.0359 inch (0.91 mm) minimum frame, or aluminum extrusions, with factory baked enamel finish.
D. Color: As indicated.
E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.
F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.07 CEILING LINEAR EXHAUST AND RETURN GRILLES

A. Type: Streamlined blades with 90-degree one-way deflection, 1/8 by 3/4-inch (3.2 by 19 mm) on

1/4-inch (6 mm) centers.

B. Frame: 1-1/4-inch (32 mm) margin, extra heavy for floor mounting, with countersunk screw mounting.
C. Fabrication: Steel with 20 gage, 0.0359 inch (0.91 mm) minimum frames and 22 gage, 0.0299 inch (0.76 mm) minimum blades, steel and aluminum with 20 gage, 0.0359 inch (0.91 mm) minimum frame, or aluminum extrusions, with factory baked enamel finish.
D. Color: As indicated.
E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.08 CEILING EGG CRATE EXHAUST AND RETURN GRILLES

A. Type: Egg crate style face consisting of 1/2 by 1/2 by 1/2-inch (13 by 13 by 13 mm), 1/2 by 1/2 by 1 inch (13 by 13 by 25 mm), and 1 by 1 by 1 inch (25 by 25 by 25 mm) grid core.
B. Fabrication: Grid core consists of aluminum with mill aluminum finish.
C. Color: As indicated.
D. Frame: 1-1/4-inch (32 mm) margin with countersunk screw mounting.
E. Frame: Channel lay-in frame for suspended grid ceilings.
F. Accessories: Provide integral, gang & face operated opposed blade damper, 2-inch filter frame (50 mm filter frame), plaster frame, square mesh insect screen, square mesh debris screen, prescored molded fiberglass back, and 45-degree angled eggcrate or other similar provisions for visual blocking such as angled louver, 90-degree duct elbow, etc.

2.09 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing with spring or other device to set blades, vertical face, single deflection.
B. Frame: 1-1/4-inch (32 mm) margin with countersunk screw mounting and gasket.
C. Fabrication: Steel with 20 gage, 0.0359 inch (0.91 mm) minimum frames and 22 gage, 0.0299 inch (0.76 mm) minimum blades, steel and aluminum with 20 gage, 0.0359 inch (0.91 mm) minimum frame, or aluminum extrusions, with factory baked enamel finish.
D. Color: As indicated.
E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.
F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.10 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with spring or other device to set blades, vertical face.
B. Frame: 1-1/4-inch (32 mm) margin with countersunk screw mounting.
C. Fabrication: Steel frames and blades, with factory baked enamel finish.
D. Color: As indicated on the drawings.
E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.
F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.11 WALL GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Fixed grilles of 1/2 by 1/2 by 1/2-inch (13 by 13 by 13 mm) louvers.
B. Fabrication: Aluminum with factory clear lacquer finish.
C. Color: As indicated.
D. Frame: Channel lay-in frame for suspended grid ceilings.
E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.12 LINEAR WALL REGISTERS/GRILLES

A. Type: Streamlined blades with 0-degree deflection, 1/8 by 3/4-inch (3.2 by 19 mm) on 1/4-inch (6 mm) centers.
B. Frame: 1-1/4-inch (32 mm) margin with countersunk screw mounting and gasket.
C. Fabrication: Aluminum extrusions, with factory baked enamel finish.
D. Color: As indicated.
E. Damper: Integral gang-operated opposed blade damper with removable key operator, operable from face.

2.13 DOOR GRILLES

A. Type: V-shaped louvers of 20 gage, 0.0359-inch (0.91 mm) thick steel, 1-inch (25 mm) deep on 1/2-inch (13 mm) centers.
B. Frame: 20 gage, 0.0359-inch (0.91 mm) steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

2.14 LOUVERS

A. Type: 4 inch (100 mm) deep frame with blades on 45-degree slope with center baffle and return bend, heavy channel frame, 1/2 inch (13 mm) square mesh screen over intake or exhaust end.
B. Fabrication: 16 gage, 0.0598 inch (1.52 mm) thick galvanized steel thick galvanized steel welded assembly, with factory prime coat finish.
C. Color: As indicated on the drawings.
D. Mounting: Furnish with interior flat flange for installation.

2.15 ROOF HOODS

A. Fabricate air inlet or exhaust hoods in accordance with SMACNA (DCS).
B. Fabricate of galvanized steel, minimum 16 gage, 0.0598 inch (1.52 mm) base and 20 gage, 0.0359 inch (0.91 mm) hood, or aluminum, minimum 16 gage, 0.0598 inch (1.52 mm) base and 18 gage, 0.0598 inch (1.21 mm) hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch (13 mm) square mesh for exhaust and 3/4 inch (19 mm) for intake, and factory prime coat finish.
C. Fabricate louver penthouses with mitered corners and reinforce with structural angles.
D. Mount unit on minimum 12 inch (300 mm) high curb base with insulation between duct and curb.
E. Make hood outlet area minimum of twice throat area.

2.16 GOOSENECKS

A. Fabricate in accordance with SMACNA (DCS) of minimum 18 gage, 0.0598 inch (1.21 mm) galvanized steel.
B. Mount on minimum 12 inches (300 mm) high curb base where size exceeds 9 by 9 inches (230 by 230 mm).

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
C. Install diffusers to ductwork with airtight connection.
D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Division 09 90 00.

DIVISION 23 37 00 – VARIABLE FREQUENCY DRIVES

GENERAL

Provide 3-year parts and labor warranty.

All VFD's shall have factory startup.

Drives shall have UL listed bypass with disconnect circuit breakers without a need for external input fuses. The bypass system shall be designed for stand-alone operation and shall be completely functional in both Hand and Automatic modes. Systems with redundancy do not require bypass.

Drive shall have BACnet interface to EMS. The drive shall have programmable LCD display with circuit breaker disconnect with a 100 KAIC short circuit breaker.

Cooling tower VFDs shall be Nema-4X with circuit breaker and a redundant drive. Installed VFDS outside and as close as possible to the tower. Any VFDs mounted outdoors must have Nema-4X factory enclosure.
The manufacturer shall provide factory training for two eight-hour sessions on service and maintenance classes for up to 10 MSCS HVAC technicians. One at the close of the project and the second later. Coordinate training dates with MSCS. This is in addition to the walk-through training at the school.

DIVISION 23 38 00 – COMMERCIAL-KITCHEN HOODS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cooking hoods.
B. Condensate (dishwashing) hoods.

1.02 RELATED REQUIREMENTS

A. *Division 10 44 00* - Fire Protection Specialties: Hand held fire extinguishers.
B. *Division 21 13 00* - Fire-Suppression Sprinkler Systems: Connection of hood fire extinguishing system to sprinkler system.
C. *Division 22 10 06* - Plumbing Piping Specialties: Floor drains for indirect discharge.
D. *Division 22 10 06* - Plumbing Piping Specialties: Electrically operated gas valve for cooking equipment.
E. *Division 23 31 13* - HVAC Ductworks: Exhaust and make-up air ducts.
F. *Division 23 34 00* - Centrifugal HVAC Fans: Kitchen exhaust fans.
G. *Division 28 46 00* - Fire Detection and Alarm: Connection of hood fire extinguishing system and fire dampers to building fire alarm system.

1.03 PRICE AND PAYMENT PROCEDURES

A. See *Division 01 23 00* - Alternates, for product alternatives affecting this section.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions, adjusting and balancing methods.
C. Shop Drawings: For each custom fabricated unit, provide drawings showing details of construction, dimensions, and interfaces with adjacent construction.
D. Test Reports for Grease Extracting Hoods: Provide test reports substantiating exhaust volume ratings and grease extraction performance.
E. Operation and Maintenance Data.
F. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Detergent for Water Wash System: 5 gallons (20 liters).

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. At least five years' experience in the design and manufacture of products of similar type to those specified.
   2. For grease extracting hoods, able to provide test data showing performance of hoods to be provided.
   3. Having at least one factory-authorized service agency located within 50 miles (80 km) of project site.
   4. Able to provide service to project site within 24 hours after receiving a service call.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Grease Extracting Hoods:
   1. Grease Master: www.greasemaster.com.
   2. Greenheck Fan Corporation: www.greenheck.com.
   3. Halton, Halton Food Service Group: www.halton.com.
   4. Substitutions: See *01 60 00* - Product Requirements.
B. Other Hoods:
   1. Same manufacturer as for grease extracting hoods.

2.02 HOOD CONSTRUCTION

A. Provide products that comply with NFPA 96, the requirements and recommendations of SMACNA (KVS), and the requirements of the Authorities Having Jurisdiction.

B. Cooking Hoods: Provide Type I hoods, with all external joints and seams continuously welded, liquid-tight, and all internal joints, seams, and attachments sealed liquid-tight and grease-tight.
   1. Provide fire extinguishing system for all cooking hoods.
   2. Provide complete assemblies listed and labeled by UL under UL 710 for its intended use.
   3. Provide hoods and exhaust ducts rated for zero clearance to combustible construction.
   4. Provide complete assemblies certified and labeled by NSF under NSF 2.

C. Condensate Hoods: Provide Type II hoods with all joints and seams liquid-tight.
   1. Inside the bottom perimeter provide an integral formed condensate gutter:
   2. Gutter Dimensions: 3 inches (75 mm) wide with one inch (25 mm) flange turned up at 45-degree angle.
   3. Drain: Stainless steel, one inch (25 mm) diameter, located in back corner of gutter.
   4. Pipe drain to nearest sink drainboard or floor drain.
   5. Provide complete assemblies certified and labeled by NSF under NSF 2.

D. Construction: Materials, inside and out, are stainless steel complying with ASTM A666, Type 304, stretcher leveled; unless otherwise indicated.
   1. Sheet Thickness: 18 gage, 0.048 inch (1.22 mm), minimum.
   2. Fabrication: Fabricate each individual hood in one piece, with all welds ground and finished to match (inside and out); fabricate flat surfaces exposed to view as double-pan formed panels with internal stiffener members.
   3. Finish on Surfaces Exposed to View: No.4 (brushed directional); provide stainless steel faces on all sides exposed to view.
   4. Finish on Concealed Surfaces: No.4 or No.2B (dull, matte).
   5. Multiple Hoods: Where total hood length in one run is over 12 feet (3600 mm), provide multiple hoods, complete in all respects, of the largest size available and of approximately equal length, mounted end to end.
      a. Provide junction boxes for field interconnection of wiring.
      b. Provide pre-drilled holes for field connections, with stainless steel fasteners; if field welding is necessary, grind and polish welds to match adjacent finish.
   6. Duct Collars: For exhaust and make-up air openings, provide duct collar welded to hood unit; minimum of 8 inches (200 mm) extension from top or back face of unit, with minimum one inch (25 mm) 90-degree flange, unless otherwise indicated.
   7. Access Panels: Provide removable or hinged access panels sufficient for maintenance and replacement of operating components inside unit; maximum width of 40 inches (1000 mm).
   8. Electrical: Run electrical wiring in conduit or raceways, factory pre-wired, with single connection point per hood.
   9. Supports: Stainless steel mounting brackets, struts, and threaded hanger rods.
      a. Hanger Rods: 3/8-inch (9 mm) diameter, minimum.
      b. Hanger Spacing: 48 inches (1220 mm) on center, maximum.
      c. Attachment to Structure: Mechanical fittings or inserts, stainless steel.
   10. Accessory Panels: Where indicated, provide filler and closure panels of same construction as hoods, to close spaces between hoods and adjacent construction; mount with panel face flush with face of hood.
      a. Where top of ceiling hung hood is lower than the finished ceiling, provide panels to close space between top of hood and ceiling.
      b. Where back of hood must be set away from wall, provide filler panels to close space between hood and wall.

E. Exhaust Air Volume Control: For balancing; provide either built-in volume control damper or separate damper in exhaust duct.

F. Make-Up Air System: Provide volume damper at inlet, accessible for balancing.
   1. Diffusers: Louvered register with opposed blade dampers.
   2. Plenum: Insulated with one inch (25 mm) thick foil-face fiberglass insulation, on inside of plenum.

G. Fire Dampers: All stainless steel, positive closing with fully enclosed spring assist.
   1. Reset Handle: Reset after actuation by pull handle located not more than 84 inches (2100 mm) above finished floor and not requiring removal of access panel.
   2. Fail-safe actuation by fusible link rated at 286 degrees F (141 degrees C).
   3. Additional actuation as specified.
   4. Provide fire dampers at exhaust outlets and make-up air inlets.

2.03 GREASE EXTRACTING HOODS

A. Grease Extracting Hoods: Pre-engineered, factory-fabricated standard products; high-velocity centrifugal grease extraction without requiring filters, cartridges, moving parts, removable parts, or constantly running water, with grease collected in gutter piped to drain, and as specified above.
   1. Performance: Remove 95 percent of extraneous matter in air stream at rated air velocity; provide substantiation.
   2. Pass-Over Hoods at Serving Lines: Designed to prevent carbonization of grease in exhaust plenum.
   3. Grease Extracting Baffles: Non-removable, adjustable for balancing.
   4. Access Panels: Provide removable panels, with handles, for access to exhaust plenum for cleaning.
   5. Label: Provide permanent label indicating rated exhaust performance.

B. Internal Water Wash System: Hot water spray to wash down all interior surfaces of entire exhaust plenum; collect wash water inside hood and pipe to point indicated for indirect connection to building drainage system.
   1. Water Temperature: 140 degrees F (60 degrees C).
   2. Water Pressure: 40 psi (275 kPa).
   3. Detergent: Inject or pump detergent into wash water lines.
   4. Supply Plumbing: Brass or stainless steel spray heads or nozzles and stainless steel distribution manifolds; factory installed, with one connection point per hood.
   5. Drain Plumbing: Drain fittings welded to bottom of plenum; interconnect multiple hoods for single drain connection.

C. Plumbing Equipment: Include the following in control panel:
   1. Water solenoid valve.
   2. Pressure reducing valve, if supply exceeds 50 psi (345 kPa).
   3. Shutoff valve, ball type.
   4. Check valve.
   5. Line strainer.
   6. Temperature/pressure gauge.
   7. Shock absorber.
   8. Vacuum breaker, ASSE 1001, in water supply line between control panel and hood.
   9. Detergent pump or injector; pump test switch.
   10. Detergent inlet with check valve.
   11. Detergent reservoir; minimum one gallon (4 liter) capacity.
   12. Wash controls.

D. Control Panel: Provide a single enclosure for all plumbing components, wash controls, and fan controls for a particular hood.
   1. Multiple hoods may be served by single wash system provided emergency actuation devices are appropriately located for each individual hood.

E. Wash Controls:
   1. Provide cleaning cycle duration timer; adjustable between 0 and 15 minutes.
   2. Shut off fan(s), if running, before starting cleaning cycle.
   3. Start wash cycle upon actuation of exhaust fire damper.
   4. Manual Actuation: Provide pushbuttons on control panel.
   5. Timed Actuation: Provide solid state, programmable controls with 24-hour, 7-day clock to set cleaning cycle duration and interval and fan on and off times.
   6. Automatic Actuation: In case of fire.
   7. Wash Zones: Provide controls capable of controlling up to 5 wash zones independently with minimum of three programmable auxiliary outputs to control user-specified devices.

8. Provide indicator lights on control panel door indicating status of wash cycle.

2.04 HOOD ACCESSORIES

A. Fire extinguishing system to comply with NFPA 96.
   1. Type: Dry-chemical type.
   2. Type: Liquid foam type.
   3. Type: Water spray system under hood and in plenum of hood, served by building sprinkler system.
   4. Exposed Piping Under Hood: Stainless steel or chrome plated.
   5. Exposed Piping Outside Hood: Not permitted.
   6. Nozzles: Stainless steel or chrome plated brass.
   7. Electrical Components: Provide all components required for properly operating system, including but not limited to wiring, raceways, contactors, circuit breakers, switches and solenoids.
   8. Fire Alarm System: Provide connection point for building fire alarm system capable of signaling system readiness and to generate signal when system is actuated.
   9. Manual Actuators: Wall-mounted pull stations; provide one near each hood and one near exit door.

B. Controls:
   1. Fans: Provide manual push button controls for starting and stopping fans and labeled indicator lights showing fan status.
   2. Fans: Provide controls for fan operation by time clock, programmable by the week, capable of maintaining time cycle after operation of manual push buttons.
   3. Hoods with Supply Air Fan: Delay starting of exhaust fan for 5 seconds after start of supply fan.
   4. Cooking Equipment: Provide manual shutoff and reset button located where indicated; combine with fire extinguishing actuation.
   5. Fire Dampers: Provide thermostatic actuation of fire dampers at 350 degrees F (176 degrees C) air temperature in exhaust duct; upon actuation of fire damper, automatically:
      a. Shut off fans serving that hood.
      b. Shut off fuel source to equipment under hood; actuate solenoid gas valves provided as part of gas piping work.
      c. Shut off electric power to equipment under hood; actuate contactors or switches provided as part of electrical work.
      d. Initiate automatic wash system and continue operation for 5 minutes after temperature falls below actuation temperature.
      e. Signal building fire alarm system; normally-open contacts.
   6. Fire Extinguishing System: Provide automatic actuation complying with NFPA 96; provide local and remote manual actuating stations clearly labeled "Hood Fire Protection"; upon actuation of fire extinguishing system, automatically:
      a. Shut off fans serving that hood.
      b. Shut off fuel source to equipment under hood; actuate solenoid gas valves provided as part of gas piping work.
      c. Shut off electric power to equipment under hood; actuate contactors or switches provided as part of electrical work.
      d. Signal building fire alarm system; normally-open contacts.
   7. Internal Water Wash System: Provide interlock to shut off fan(s) prior to starting wash cycle; provide wash controls as specified.

C. Control Panels: Factory assembled and pre-wired, ready for utility connections.
   1. UL listed for use with specific hood.
   2. Provide a single control panel combining all control functions for a particular hood, unless otherwise indicated.
   3. Provide a single control panel for each group of hoods served by a single exhaust fan.
   4. Enclosures: Flush-mounted; stainless steel, to match hood.
   5. Provide indicator lights on control panel door showing status of fans and power supply.

D. Lights Inside Hoods: Fluorescent and incandescent in quantity and locations indicated, in UL listed vapor-proof fixtures, pre-wired to junction box on top of hood.

1. Fluorescent: Standard bi-pin base; recessed or surface mounted.
    a. Tube Color: Cool white.
    b. Tube Diameter: 1-1/2 inch (38 mm).
    c. Tube Length: 48 inches (1220 mm).
2. Incandescent: Flush mounted, glass lens; 75-watt bulb.
3. Incandescent: Surface mounted, thermal shock proof glass globe with chrome plated steel wire guard; 100-watt bulb.
4. Locate switch for operating lights in locations indicated.

E. Grease Filters: Stainless steel, washable, complying with UL 1046, UL listed and labeled;
F. Exhaust Ducts: 18 gage, 0.048 inch (1.22 mm) stainless steel sheet, ASTM A666; with external seams welded continuously, liquid-tight; see drawings for extent, location, and size of exhaust ducts.
    1. Where ducts penetrate ceilings or walls, provide stainless steel angle flange trim with welded corners, 16 gage, 0.06 inch (1.5 mm) minimum thickness.
    2. Where ducts penetrate hood body, provide stainless steel angle flange trim with welded corners and seal joints liquid-tight.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that overhead supports are installed in correct locations.
B. Do not begin installation until substrates have been properly prepared.
C. If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and NFPA 96.
B. Install hoods level and plumb, securely fastened, with seismic restraints as specified, and free of vibration during normal operation.
C. Weld hood duct collars to ductwork, liquid-tight.
D. Connect to utilities.

3.04 SYSTEM STARTUP

A. Obtain the services of the manufacturer's representative experienced in the installation, adjustment, and operation of the equipment to supervise the starting and adjusting of equipment.
B. Prepare equipment for startup, start and operate equipment for sufficient period to verify proper operation; correct equipment not operating correctly.
C. Test liquid carrying components for leaks.
D. Adjust volume dampers as required for proper air flow after building air handling systems have been balanced and adjusted.
E. Demonstrate operation to Owner's designated personnel.
F. Demonstrate operation to authorities having jurisdiction if required by them; comply with their requirements for demonstration.
G. Report deficiencies in writing to Architect/Engineer.

3.05 CLOSEOUT ACTIVITIES

A. Conduct training of Owner's designated personnel in the operation and maintenance of equipment.
B. Perform at least 2 hours of training, for minimum of 2 people, at project site.
C. Arrange training sessions with Owner at least 2 weeks in advance.
D. Have operation and maintenance data on hand for training sessions.

3.06 CLEANING

A. Clean surfaces of equipment.

3.07 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

DIVISION 23 40 00 – HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Disposable, extended area panel filters.
B. Disposable panel filters.
C. Filter frames and housing.

1.02 RELATED REQUIREMENTS

A. *Division 01 50 00* - Temporary Facilities and Controls: Filters for temporary heating and ventilating.

1.03 REFERENCE STANDARDS

A. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).
B. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods; 2015b.
C. UL 586 - High Efficiency, Particulate, Air Filter Units; Current Edition, Including All Revisions.
D. UL 900 - Standard for Air Filter Units; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.
C. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.
D. Samples: Submit two samples of replacement filter media of each type and each filter frame.
E. Manufacturer's Installation Instructions: Indicate assembly and change-out procedures.
F. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Extra Filters: One set of each type and size.

1.05 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 FILTER MANUFACTURERS

A. American Filtration Inc: www.americanfiltration.com.
B. AAF International/American Air Filter: www.aafintl.com.
C. The Camfil Group: www.camfilfarr.com.
D. Approved Equal.
E. Substitutions: See *01 60 00* - Product Requirements.

2.02 DISPOSABLE, EXTENDED AREA PANEL FILTERS

A. Media: UL 900 Class 1, pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded wire grid by corrugated aluminum separators.
    1. Frame: Non-flammable.
    2. Nominal size: 12 by 24 inches (305 by 610 mm).
    3. Nominal thickness: 1 inch (25 mm).
B. Minimum Efficiency Reporting Value (MERV): 13, when tested in accordance with ASHRAE Std 52.2.
C. Rating, per ASHRAE Std 52.2:
    1. Weight arrestance: 85 percent.
    2. Initial resistance at 500 FPM (2.54 m/sec) face velocity: 0.20-inch WG (50 Pa).
    3. Recommended final resistance: 0.9-inch WG (224 Pa).

2.03 DISPOSABLE PANEL FILTERS

A. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
    1. Thickness: 1 inch (25 mm).

B. Performance Rating:
   1. Face Velocity: 500 FPM (2.54 m/sec).
   2. Initial Resistance: 0.15-inch WG (37 Pa).
   3. Recommended Final Resistance: 0.50 inches WG (125 Pa).
C. Casing: Cardboard frame.
D. Holding Frames: 20 gage, 0.0359 inch (0.91 mm) minimum galvanized steel frame with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

2.04 FILTER FRAMES AND HOUSINGS

A. General: Fabricate filter frames and supporting structures of 16 gage, 0.0598 inch (1.52 mm) galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.
B. Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters, size for 24 by 24 inches (610 by 610 mm) filter media, minimum 2 inches (50 mm) thick; for extended surface and high efficiency particulate air filters, provide for upstream mounting of panel filters.
C. Side Servicing Housings: Flanged for insertion into ductwork, of reinforced 16 gage, 0.0598 inch (1.52 mm) galvanized steel; access doors with continuous gasketing and positive locking devices on both sides; extruded aluminum tracks or channels for primary secondary filters with positive sealing gaskets.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.
B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
C. Install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.
D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters during construction and testing every 4 months, with clean set. Date filters. Provide new filters when construction is complete. Provide one set of filters for attic stock to Owner.

DIVISION 23 45 00 – PACKAGED WATER CHILLERS

GENERAL

Provide air cooled scroll chillers from 10 to 240 tons with medium and high-pressure refrigerant without a phaseout date.

Provide 5-year complete parts, labor, refrigerant, warranty, and factory service maintenance contract. Service contract is based on full manufacturer task list with quarterly and yearly tasks. A complete report shall be provided to MSCS each quarter and on a yearly basis for each chiller. Chillers must include factory start-up.

Chiller shall control the pump using a hardwire interlock by BAS contractor. EMS shall enable/disable the chiller. BACnet interface with EMS integrations.
Provide motorized isolation valves for each chiller. BAS contractor shall incorporate control of the valves.
Provide thermal dispersion flow switches and strainer at the chiller. BAS contract should be provided.
All chillers shall have factory disconnect switch, GFI, phase under/over protection, ground fault protection, isolation service valves, replaceable core filter dryer with isolation valves, insulated suction lines, sound kit for compressor and fans, metal louvers for entire chiller.
Magnetic chillers shall be medium or high pressure with refrigerant cooled hermetic compressors. Refrigerant shall not have a phase out date. MSCS prefers non-blend refrigerant without temperature glide. Open drive compressors are not acceptable due to additional required service and maintenance costs. Screw compressor is not acceptable due to noise issues. Provide VFD for each chiller.

MSCS prefers Chiller to control pumps and tower operation. Design Engineer to evaluate and recommend best control options. MSCS to review Sequence of operations.
BAS contractor shall provide a head pressure control valve for all water-cooled chillers. Head pressure control valves shall be controlled by their respective chillers.

Water cooled Chillers shall control the cooling tower VFDs when possible.
Manufacturer shall offer local factory service and maintenance class for up to 10 MSCS HVAC technicians Coordinate training dates with MSCS.

All open loop hydronic systems shall have bypass feed with cartridge filter and air/ dirt separator with blowdown to floor drain. The contractor shall install a drain valve and P/T ports in both pipes at each chiller.
All centrifugal chillers shall be medium to high pressure refrigerant with dual compressors for redundancy. MSCS requires hinged water boxes for centrifugal chillers for both ends of evaporator and condenser. The contractor shall insulate the headers.

The contractor shall provide and install temporary cooling hook-ups shall be 6" connections with isolation valves. Provide two (2) 6" to 4" reducers.

The manufacturer shall factory train for two eight-hour sessions on service and maintenance class for up to 3 MSCS HVAC technicians. One at the close of the project and the second later. Coordinate training dates with MSCS. This is in addition to the walk-through training at the school.

DIVISION 23 50 00 - COOLING TOWERS

GENERAL

The cooling tower shall be installed on a foundation that meets all related current adopted code criteria. A basis- of- design may include reinforced concrete piers or concrete slab designed by structural engineer with the suction outlet located above the centerline of the condenser water pump of sufficient height to provide proper NPSH to the pump. Cooling towers are to be included in the one-year service agreement for the HVAC system. Contractor to provide pipe size temporary hookup connections with isolation valves.

The cooling shall have two (2) fans.

The overflow/drain shall be piped full size to the storm drainage system or sewage system as code or municipal rules dictate.

Provide VFDs or new motor starters. BAS to monitor the tower VFDs and motor starter for alarm/status.

Provide gated fence enclosure around cooling tower of sufficient size to allow access and maintenance of the tower. May reuse pad and fencing if manufacture specification is meet.
Provide Cooling Tower treatment prior to start up with near neutral pH water and use of only reasonable levels of film forming inhibitors. The contractor shall verify water treatment system shall be fully functional and operable.

MSCS chemically treats the process water in HVAC systems. Designer to ensure chemical feeders are included in project documents for the implementation of the chemicals into the HVAC system at time of operation.
Contractor shall coordinate with MSCS chemical treatment vendor to pre-treat (passivate) cooling tower per manufacturer's requirements before placing into service. This is not required for fiberglass towers.

MSCS recommends that the basis of design be a reinforced fiberglass cooling tower with seamless basin, dual fans for redundancy and mechanical ball float level for makeup water. MSCS prefers the cooling towers to have a 5-year warranty against rust and 5-year motor part warranty. Pretreatment is not required for Reinforced Fiberglass Cooling Towers.
An alternate stainless steel cooling tower design with welded, seamless, stainless-steel basin with dual fans for redundancy and mechanical ball float level for makeup is acceptable equivalent to cooling tower design and meet the same performance as the basis-of-design. Provide 5-years motor parts warranty and 5-years warranty against rust.

With the following accessories:

- Ladder
- Permitter handrails
- Vibration switch
- Mechanical ball float level only. Water lever using solenoids is not acceptable.
- Low sound fans
- Direct drive fan motor or gear driven belt is not acceptable.

Contractor to provide connections with isolation valves for temporary Tower connections.

The manufacturer shall provide factory training for two eight-hour sessions on service and maintenance class for up to 3 MSCS HVAC technicians. One at the close of the project and the second later. Coordinate training dates with MSCS. This is in addition to the walk-through training at the school.

DIVISION 23 60 00 – PACKAGED OUTDOOR ROOF TOP HVAC EQUIPMENT

GENERAL

Roof Top units shall have the minimum manufacturer warranty, 10-year heat exchange parts warranty (Stainless Steel HX only), 5-year complete unit parts warranty and 1-year manufacturer labor warranty. Warranty starts at substantial completion. Startup shall be performed by manufacturer.
Units serving classrooms with 3-6 tons shall meet minimum 15.2 SEER 2 rating. MSCS prefers and recommends energy efficient two stage compressors. VFD compressors are not recommended but will be reviewed and approved on a case-by-case basis for specification inclusion.
Units 7.5 tons and larger shall have a minimum of two refrigeration circuits. MSCS prefers and recommends energy efficient two stage compressors. VFD compressors are not recommended but will be reviewed and approved on a case-by-case basis for specification inclusion. All units are required to have compressor vibration isolation.

Unit controllers shall have a unit mounted user interface with digital display. Provide wall mounted temp/humidity sensor with LCD display, override, and metal guard.
Hot gas reheat coil is required for all classroom RTUs.

Direct Drive ECM motors for all classrooms roof top units. Belt drive & VFD will not be acceptable. RTUs to have phase protection and condenser coil hail guards.
Units will be commissioned to the indoor air quality procedures as dictated by ASHRAE. BACnet interface card should be provided for all RTUs to interface with BAS.
Demand Control Ventilation with CO2 control measuring sensor to MSCS BACnet front end graphics.
Roof curb shall be seismic and curb height shall be determined in relation to roof slope at the specific unit. The basics of design shall use a minimum 18 inches above roof.

Hinged access doors with door handles. Provide exhaust as required by Design Engineer to maintain proper building pressure. All roof top units shall have factory mounted non-fused disconnect switch and factory powered 120-volt convenience outlet.

The manufacturer shall provide factory training for two eight-hour sessions on service and maintenance class for up to 10 MSCS HVAC technicians. One at the close of the project and the second later. Coordinate training dates with MSCS. This is in addition to the walk-through training at the school.

All roof top units have a minimum of 2 stages of primary heat and 2-stage cooling. All roof top units have non-corrosive drain pan with condensate overflow switches. Roof top shall use medium or high-pressure refrigerant without a phaseout date. Condenser fans to be direct drive.

Provide bipolar needlepoint ionizers with self-cleaning function and meet the UL-2998 non-ozone certificate criteria. Designers may use the manufacturer, GPS, as a basis of design.

DIVISION 23 70 00 – PACKAGED AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Energy recovery units.
B. Casing.
C. Fans.
D. Total energy wheel.
E. Filters.
F. Dampers.
G. Vibration isolation.
H. Roof curbs.
I. Power and controls.
J. Accessories.
K. Service accessories.

1.02 RELATED REQUIREMENTS

A. *Division 07 72 00* - Roof Accessories: Roof curb.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's installation instruction, product data, and engineering calculations.
C. Shop Drawings: Show design and assembly of energy recovery unit and installation and connection details.
D. Samples: Submit sample showing custom paint colors.
E. Manufacturer's Qualification Statement.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Spare Parts: One of each kind of filter.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications:
    1. Firm regularly engaged in manufacturing energy recovery units.
    2. Products in satisfactory use in similar service for not less than five years.
    3. Manufactured and assembled in the United States of America.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store in manufacturer's unopened packaging.
B. Store products to be installed indoors in dry, heated area.

1.06 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.
B. Warranty ventilator to be free from defects in material and workmanship and of all parts for period of 1-1/2 years from date of Substantial Completion.
C. Warranty energy recovery wheel to be free from defects in material and workmanship for 3 years under circumstances of normal use.
D. Warranty motor to be free from defects in material and workmanship for 7 years under circumstances of normal use.
E. Warranty dessicant core to be free from defects in material and workmanship for 5 years under circumstances of normal use.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Energy Recovery Ventilators:
    1. Berner International: www.berner.com.
    2. Fantech: www.fantech.net.
    3. Semco Inc.: www.semcohvac.com.
    4. Systemair AB: www.systemair.com.
    5. Greenheck: www.greenheck.com.
    6. Substitutions: See *Division 01 25 00* - Substitution Procedures.

2.02 ENERGY RECOVERY DESIGN CRITERIA

A. See drawing schedules.
B. Power Supply Electrical Characteristics: See drawing schedules.

2.03 ENERGY RECOVERY UNITS

A. Energy Recovery Units: Dessicant wheel type; prefabricated packaged system designed by manufacturer.
   1. Access: Hinged and/or screwed access panels on front.
   2. Lifting holes at the unit base.
   3. Framing: Welded extruded aluminum tubular frame capable of supporting components and casings.
   4. Permanent name plate listing manufacturer mounted inside door near electrical panel.

2.04 CASING

A. Wall, Floor, and Roof Panels:
   1. Panels: Removable.
   2. Construction: 2 inch thick, double wall box construction, with formed edges of exterior wall overlapping formed edges of interior wall.
   3. Aluminum is standard. Factory-painted aluminized steel is an economic alternative when the higher corrosion resistance of aluminum is not required.
   4. Exterior Wall: Galvanized steel sheet.
      a. 20 gage, 0.0359 inches (0.91 mm) galvanized steel.
      b. 0.040 inches (1 mm) thick aluminum.
      c. Color: Gray.
   5. Interior Wall: Galvanized sheet metal.
      a. 20 gage, 0.0359 inches (0.91 mm) aluminized steel.
      b. 22 gage, 0.0299 inches (0.76 mm) galvanized sheet metal.
   6. Insulation:
      a. 1 inch (25 mm) insulated fiberglass.
      b. Panel Cores: Mineral wool board.
      c. Include antimicrobial protection.
      d. Mold Resistance: "Pass" when tested according to ASTM C1338.
      e. Flame Spread Index (FSI): 25 or less, when tested in accordance with ASTM E84 or UL 723.
      f. Smoke Developed Index (SDI): 50, maximum, when tested in accordance with ASTM E84 or UL 723.
      g. Secure insulation to unit with waterproof adhesive and permanent mechanical fasteners.
   7. Roof Panel: Weatherproof.
   8. Panel Joints: T-shaped standing seams with overlapping metal caps.
   9. Fasteners: Stainless steel.
   10. Isolation and Seal: Form continuous, thermally isolated, weather tight seal between inner wall of panels and structural framing with closed cell PVC foam gasketing.
   11. Seams: Sealed, requiring no caulking at job site.
   12. Coating: Polyurethane enamel.
B. Access Panels: Provide access to components through a large, tightly sealed and easily removable panel.
C. Doors:
   1. Construct doors of same construction and thickness as wall panels.
   2. Height: 80 inches (2032 mm).
   3. Hardware:
      a. Hinges: Aluminum.
      b. Corrosion-resistant.
      c. Provide exterior handle and interior 3-point latching device.
      d. Prop Rod: Capable of propping doors in open position.
      e. Wind Restraint: Door chain with spring to absorb force of door swinging open.
      f. Gasket: P-shaped extruded neoprene.
      g. Label each door to identify equipment located within.
D. Trim: 0.08 inches (2 mm) aluminum, continuously welded.
E. Install panels on structural framing with self-tapping stainless steel screws with integral neoprene-backed stainless steel washers.

F. Duct Connection Collars: 0.08 inches (2 mm) aluminum, continuously welded.
G. Weather Hood: Provide on fresh air inlet and exhaust air outlet; removable for access.
    1. Construction: ASTM A653/A653M, G90/Z275 galvanized, 20 gage, 0.0359 inches (0.91 mm) steel sheet.
    2. Construction: 0.08 inches (2 mm) thick aluminum with stainless steel fasteners and continuous welding.
    3. Screening: Expanded aluminum bird screen.
    4. Fresh Air Weather Hood: Maintain a face velocity less than 340 feet/min (1.6 m/s).

2.05 FANS

A. Provide separate fans for exhaust and supply blowers.
B. Fans:
    1. Individually driven with a dedicated motor.
    2. Backward inclined.
    3. Single width, single inlet.
    4. Class 1 aluminum wheels.
    5. AMCA-rated.
    6. Provide with non-overloading characteristics.
    7. Provide non-sparking integral spun steel venturie inlet cones.
C. Bearings:
    1. Pillow block.
    2. Bearings: Permanently lubricated sealed ball bearings.
    3. Rated for not less than 200,000 hours of operation with accessible greased fittings.
D. Housings: 12 gage, 0.1046 inch (2.66 mm) aluminized steel with plenums integral to general housing and constructed to Class 1 fan standards.
E. Motors:
    1. Motors: Open drip proof.
    2. Efficiency: High.
    3. Speed: Single.
    4. Control: Constant Speed.
    5. Motor Slide Bases: Removable and adjustable.
    6. Fan Motor: Thermal overload protected.
    7. Fan Motor: UL listed and labeled.
F. Belt Guards: Full sized, hinged, painted with high-visibility safety color, and accessible with standard tools.

2.06 TOTAL ENERGY WHEEL

A. Wheel: Transfer heat and humidity from one air stream to the other with minimum carryover of the exhaust air into the supply air stream.
B. Energy Wheel Media: Cleanable with low temperature steam, hot water or light detergent, without degrading the latent recovery.
C. Wheel Effectiveness: Rated in accordance with ASHRAE Std 84 and AHRI 1060 (I-P).
D. Flame Spread Index (FSI): 25 or less, when tested in accordance with ASTM E84 or UL 723.
E. Smoke Developed Index (SDI): 50 or less, when tested in accordance with ASTM E84 or UL 723.
F. Energy Recovery Wheel Media Face:
    1. Comply with NFPA 90A.
    2. Coating: Acid resistant coating.
G. Coat all corrugated surfaces with a thin non-migrating absorbent layer.
H. Wheel Cassette: Easily removable from the unit.
I. Rotor:
    1. Type: Non-segmented hygroscopic aluminum wheel.
    2. Mounted on permanently lubricated bearings.
    3. Rotor Matrix: Corrosion resistant aluminum alloy composed of alternating corrugated and flat, continuously wound layers of uniform widths.
    4. Depth: 8 inches (203 mm).
    5. Rotor Wheel: Reinforce with spokes, welded at the hub and perimeter to prevent any uneven run out during normal operations.

J. Desiccant:
    1. Type: 3A.
    2. Performance:
        a. Desiccant: Non-dissolving, permanent, and resistant to damage from compressed air, low temperature steam, hot water or by vacuum cleaning.
    3. Ventilation Factor: 1.00.
K. Pneumatic Seals: Extruded adjustable brush seals.
    1. Locations:
        a. Around perimeter of wheel, and mounted perpendicular to face of wheel.
        b. Separation between exhaust and supply air streams on both sides of wheel.
    2. Pressure Differential: Adjustable by means of a lockable quadrant operator.
L. Drive:
    1. Drive: Tensioned drive with full perimeter link style belt.
    2. Inertial Shock Absorber: Absorb start and stop inertial shock to gear reducer.
    3. Select above or below depending on type of motor required.
M. Purge Angle:
    1. Purge Angle: Field adjustable from zero to six degrees of rotor circumference arc to suit the prevailing pressure conditions.
    2. Divert sufficient supply air to accomplish full purging of exhaust-air from energy wheel to achieve no cross contamination.
N. Wheel Rotation Detection:
    1. Turn off energy recovery unit if improper rotor rotation is detected.
    2. Send alarm to Building Management System if rotation is not detected or belt is slipping.
    3. Retain the following when calculations indicate frost could form on energy wheel. Note that frost control is not required when using variable frequency drive motors on wheel.

2.07 FILTERS

A. Exhaust and Fresh Air Streams: MERV 7 filters constructed to meet ASHRAE Std 52.2.
B. Filter Racks: Bolt-on rack constructed of 0.08 inches (2 mm), minimum, thick aluminum with hinged side access door and snap fasteners.
C. Pre-Filter: 30-30 pleated filters, 2 inches (50 mm) thick on outside air inlet.
D. Filter Removal Hooks: Provide means to remove filters that are not immediately accessible from exterior of unit
E. Mount 1/2 inches (13 mm) thick permanent aluminum washable type filter in the outside air hood and in the return plenum air.
F. Provide spare set of filters.

2.08 DAMPERS

A. Exhaust Back-Draft Damper: Factory installed, galvanized steel.
    1. High performance, backdraft dampers suitable for application in HVAC systems with velocities to 3000 feet per minute (914 m/min).
    2. Louvers, Dampers, and Shutters: AMCA 500-D and AMCA 500-L.
    3. Damper Capacity: Demonstrate damper capacity to withstand HVAC system operating conditions.
        a. Closed position: 6 inches w.g. (1.5 kPa).
        b. Open position: 3000 feet per minute (914 m/min).
    4. Fabrication:
        a. Frame: 20 gage, 0.0359- i n c h (0.91 mm), 3-inch (76 mm) roll formed galvanized steel channel with rear flange, pre-punched mounting holes, and welded corner clips for maximum rigidity.
        b. Blades:
            1) Style: Single-piece, overlap frame.
            2) Material: Roll formed 28 gage, 0.0149 inch (0.38 mm) galvanized steel.
            3) Width: Maximum 6 inches (152 mm).
        c. Blade Seals: Extruded vinyl, mechanically attached to the blades edge.
        d. Linkage: Galvanized steel tie bar with stainless steel pivot pins mounted on blades.
        e. Axles: Stainless steel.
        f. Mounting: Vertical.

g. Finish: Mill galvanized.

B. Return Air Damper:
1. Factory installed, adjustable volume control, opposed blade damper for regulating airflow, based on external static pressure.
2. Conceal linkage out of air stream, within damper frame to reduce pressure drop and noise and lessen need for maintenance.
3. Form from single piece of minimum 16 gage, 0.0598 inch (1.52 mm) galvanized steel.
4. Return Air Damper: Structural hat channels, reinforced at corners.
5. Roll-formed Frames: Structurally superior to 13 gage, 0.0897-inch (2.28 mm) U-channel frames.
6. Blades: Single skin, 16 gage, 0.0598 inch (1.52 mm).
7. Bearings: Corrosion resistant, molded synthetic sleeve type turning in extruded hole in damper frame.

C. Return Air Inlets: Provide expanded metal grating in welded frame to prevent items larger than 1/2 inch (13 mm) in diameter from falling into ducts below.

D. Motorized Dampers: Provide motorized dampers at outside air inlet, exhaust air outlet, and supply air outlet.
1. Type: Motorized two position parallel blade damper with blade seals.
2. Motorized Damper: Roll-formed structural hat channels, reinforced at the corners,
3. Formed from single piece of minimum 16 gage, 0.0598 inches (1.52 mm) galvanized steel.
4. Blades: Single skin, 16 gage, 0.0598 inches (1.52 mm).
5. Blade Edge Seals: PVC coated polyester fabric suitable for minus 25 degrees F (32 degrees C) to 180 degrees F (83 degrees C).
6. Jamb Seals: Flexible stainless, compression type to prevent leakage between end of the blade and the damper frame.
7. Bearings: Corrosion resistant, molded synthetic sleeve type turning in extruded hole in damper frame.
8. Conceal linkage out of air stream, within damper frame to reduce pressure drop and noise and lessen need for maintenance.

E. Motorized Louvers:
1. Type: Motorized two position parallel blade louver with drainable blades, blade seals, and jamb seals
2. Locations: Provide at outside air inlet.
3. Adjustable louver:
a. Fabrication: Mullion style.
1) Frame:
(a) Depth: 4 inches (102 mm).
(b) Material: Extruded aluminum, Alloy 6063-T5.
(c) Wall Thickness: 0.081 inches (2.1 mm).
2) Blades:
(a) Style: Horizontal, adjustable, drainable.
(b) Material: Formed aluminum, Alloy 6063-T5.
(c) Thickness: 0.081 inches (2.1 mm).
(d) Angle: 45 degrees .
(e) Centers: 5 inches (127 mm).
(f) Linkage: Concealed in frame.
(g) Bearings: Stainless steel sleeve pressed into frame.
(h) Axles: 1/2 inches (13 mm) plated steel hex.
(i) Provide blade and jamb seals.
3) Gutters: Drain gutter in head frame and each blade.
4) Downspouts: Downspouts in jambs to drain water from louver for minimum water cascade from blade to blade.

2.09 VIBRATION ISOLATION

A. Vibration Isolation: Provide whole unit vibration isolation with the energy recovery unit assembly.

B. Construct with appropriately-sized, seismic-rated, corrosion-resistant captive-spring isolators.

2.10 ROOF CURBS

A. Curbs: Provide full perimeter roof curb fabricated from 10 gage, 0.1345 inch (3.42 mm) aluminized steel.
   1. Curbs: Knock-down type.
   2. Provide flat for roof deck.
B. Isolation Rails: Provide factory-installed, 12 gage, 0.1046 (2.66 mm) aluminized steel angles top and bottom, connected with flexible, outdoor rated membrane and factory-installed vibration isolation springs.
C. Gaskets: Provide closed cell PVC foam.
   1. Install between top flange of isolation rail and bottom of energy recovery unit.
   2. Install on top of curb.

2.11 POWER AND CONTROLS

A. Motor Control Panels: UL listed.
B. Include necessary motor starters, fuses, transformers and overload protection according to NFPA 70.
C. Provide single-point field connection to power supply.
D. Provide non fused main disconnect integral to control panel.
E. Install wiring in accordance with NFPA 70.
F. Wiring: Enclosed in flexible, liquid tight steel conduit.

2.12 ACCESSORIES

A. Airflow Monitor:
   1. Include integral airflow monitoring station with ability to read both ventilation and exhaust airflow expressed in cu ft/min.
   2. Mount monitor gage on unit exterior and make casing connection watertight.
B. Rotation Detector:
   1. Equip unit with rotation sensor.
   2. Equip controller with outdoor air temperature sensor that stops energy recovery wheel during moderate temperature periods.
   3. Alarm Contact: 24-volt AC signal suitable for operating a relay.
   4. Provide periodic stop function long enough to promote self-cleaning of wheel but not long enough to induce energy recovery.
   5. Allow the energy recovery wheel to be operated in stop mode during very low temperature periods to prevent freezing of wheel while still delivering outdoor air through the unit.
C. Remote Indicating Panel: Provide remote indication of status of unit power on, wheel rotation alarm, outside air dirty filter and return air dirty filter.
D. Electric Preheat Coil:
   1. Resistance coil type with elements enclosed in a steel sheath with fins and painted with baked-on aluminum paint for long life in a 100 percent outdoor air stream.
   2. Coil: UL listed and constructed in accordance with NFPA 70 requirements.
E. Freeze Protection Thermostat:
   1. Equip unit with thermostat such that unit can be stopped when temperature drops to 23 degrees F (minus 5 degrees C).

2.13 SERVICE ACCESSORIES

A. Internal Service Lights: Provide vapor tight light with protective cage and minimum 40-watt bulb.
B. Electrical Receptacle:
   1. Provide duplex, ground fault interrupter type receptacle.
   2. Provide re-settable circuit breaker in control panel.
C. Switch: 2 types.
   1. Two Position Type: Service and operate.
   2. Three Position Type: Low, Standby, and Medium.
D. Electrical Components: Factory wired for single point power connection.
   1. 60 Hz power connection.
   2. Isolate electrical box from the airflow.
   3. Protect all integral wires and connections.
   4. Electrical Components: UL Listed.
   5. Electrical Panel: NEMA 3R mounted on the unit exterior for ease of access.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that structure is ready for installation of unit, that openings in deck for ductwork, if required, are correctly sized and located, and that mechanical and electrical utilities supplying unit are of correct capacities and are accessible.

3.02 INSTALLATION

A. Provide openings for suitable ductwork connection.
B. Outdoor Installations:
   1. Roof Panels:
      a. Fasteners: Use concealed means of attachment.
      b. Minimize penetrations through roof.
      c. Provide weather tight seal at required penetrations.
   2. Provide drip edge around roof perimeter.
   3. Do not locate roof panel joints above doors.

3.03 SYSTEM STARTUP

A. Provide services of manufacturer's authorized representative to provide start-up of unit.

3.04 CLEANING

A. Clean filters, air plenums, interior and exposed-to-view surfaces prior to Substantial Completion.

DIVISION 23 73 00 – MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Casing construction.
B. Fan section.
C. Coil section.
D. Integral face and bypass coil section.
E. Filter and air cleaner section.
F. Damper section.
G. Airflow measurement.
H. Total energy recovery wheel section.
I. Ultraviolet lights.
J. Air cleaning systems.
K. Indirect-fired gas heat section.
L. Multizone section.
M. Silencer section.
N. Access section.
O. Air blender section.
P. Diffuser section.
Q. Turning and discharge plenum section.
R. Controls.
S. Roof mounting curb.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation with size, location and installation of service utilities.
B. Coordinate the work with other trades for installation of roof mounted air handling units on roof curbs.
C. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
D. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data:
   1. Published Literature: Indicate dimensions, weights, capacities, ratings, gauges and finishes of materials, and electrical characteristics and connection requirements.
   2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
   3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.

4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

C. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
D. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
E. Samples: Submit two of each type of replacement filter media with frame.
F. Specimen Warranty: Submit sample of manufacturer's warranty.
G. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.
H. Manufacturer's Instructions: Include installation instructions.
I. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.
J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See *Division 01 60 00* - Product Requirements, for additional provisions.
2. Extra Fan Belts: One set for each unit.
3. Extra Filters: One set for each unit.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.07 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.
B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Daikin Applied: www.daikinapplied.com.
B. Trane Inc: www.trane.com.
C. York International Corporation / Johnson Controls Inc: www.york.com.
D. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 CASING CONSTRUCTION

A. Full Perimeter Base Rail:
1. Construct of galvanized steel.
2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.

B. Casing:
1. Construct of one piece, insulated, double wall panels.
2. Provide mid-span, no through metal, internal thermal break.
3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
4. Casing Air Pressure Performance Requirements:
a. Able to withstand up to 8 inches w.g. (2 kPa) positive or negative static pressure.
b. Not to exceed 0.0042 inches per inch (0.0042 mm/mm) deflection at 1.5 times design static pressure up to a maximum of plus 8 inches w.g. (2 kPa) in positive pressure sections and minus 8 inches w.g. (2 kPa) in negative pressure sections.

C. Access Doors:
    1. Construction, thermal and air pressure performance same as casing.
    2. Provide surface mounted handles on hinged, swing doors.
    3. Provide shatterproof viewing window designed to withstand operating pressures.
D. Outdoor Unit Roof:
    1. Factory install single layer outer roof above inner roof.
    2. Slope at a minimum of 0.125 inches per foot (10.41 mm/m) from one side of unit to the other side, or from center to sides of unit.
    3. Roof assembly to overhang each unit wall or base rail to overhang curb to facilitate water runoff and prevent water intrusion into roof curb to base connection.
E. Outside Air and Exhaust Air Weather Hood:
    1. Fabricate from same material as casing outer panel.
    2. Extend hood past perimeter of unit casing opening so as not to instruct airflow path.
    3. Paint hoods with same finish as external surface of outdoor units.
    4. Provide inlet hood for each fresh air damper with a sine wave moisture eliminator to prevent entrainment of water into the unit from outside air.
    5. Provide exhaust hoods for each exhaust air opening.
    6. Size each hood for 100 percent of nominal fresh air damper capacities.
    7. Protect each hood with bird screen to prevent nesting at intake or exhaust air flow paths.
F. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.
G. Casing Leakage: Seal joints and provide airtight access doors so that air leakage does not exceed one percent of design flow at the specified casing pressure.
H. Insulation:
    1. Provide minimum thermal thickness of 12 R (2.29 RSI) throughout.
    2. Completely fill panel cavities in each direction to prevent voids and settling.
    3. Comply with NFPA 90A.
I. Drain Pan Construction:
    1. Provide cooling coil and humidifier sections with an insulated, double wall, galvanized steel drain pan complying with ASHRAE Std 62.1 for indoor air quality and sufficiently sized to collect all condensate.
    2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
    3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
    4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.
J. Bottom Inlet Units: Provide steel or aluminum walking grate on structural supports.
K. Louvers: Stationary, of galvanized steel, 4-inch (100 mm) deep with plenum, nylon bearings, 1/2-inch (13 mm) mesh, 0.04 inch (1.0 mm) galvanized wire bird screen in aluminum frame, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500-L. Furnish adjustable louvers with hollow vinyl bulb edging on blades and foam side stops to limit leakage to maximum 2 percent at 4-inch wg (1 kPa) differential pressure when sized for 2000 fpm (10 m/s) face velocity.
L. Marine Lights:
    1. Provide factory-mounted, water- and dust-resistant LED fixture(s) where indicated on drawings, with the following characteristics:
        a. Non-ferrous metal housing.
        b. Glass or polycarbonate lens.
        c. Factory wired to a single switch within factory provided service module.
        d. Instant on white light with minimum 8000-hour service life.
    2. Provide factory installed service module including GFCI receptacle independent from load side; designed to receive power from field supplied 120-volt source.
M. Finish:
    1. Outdoor Units:
        a. Coat external surface of unit casing with primer and minimum 1.5 mil, enamel paint finish.

b. Comply with salt spray test in accordance with ASTM B177/B177M.
c. Color: Manufacturer's standard color.

2. Indoor Units:
a. Provide exterior, galvanized steel panels without paint.
b. Provide exterior, galvanized steel panels with painted surface complying with ASTM B177/B177M.
c. Color: Manufacturer's standard color.

2.03 FAN SECTION

A. Type: Forward curved, single width, single inlet, centrifugal plug type fan, in compliance with AMCA 99. Refer to Section 23 3413.
B. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.
C. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.
D. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.
E. External Motor Junction Box: Factory mount NEMA 4 external junction box and connect to extended motor leads from internally mounted motors.
F. Motor Wiring Conduit: Factory wire fan motor wiring to the unit mounted starter-disconnect, variable frequency drive, and external motor junction box.
G. Fan Accessories.
H. Flexible Duct Connections:
1. For separating fan, coil, and adjacent sections.
I. Supply Fan Performance Complying with AHRI 430 (I-P):
1. Refer to Section 26 0583.
2. Type: NEMA MG 1.
J. Return Fan Performance Complying with AHRI 430 (I-P):
1. Refer to Section 26 0583.
2. Type: NEMA MG 1.
K. Drives:
1. Comply with AMCA 99.
2. Bearings: Heavy duty pillow block type, ball bearings with ABMA STD 9 L-10 life at 50 000 hours.
3. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
4. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
5. Belt Guard: Fabricate to SMACNA (DCS); 0.106-inch (2.6 mm) thick, 3/4-inch (20 mm) diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.04 COIL SECTION

A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.
B. Drain Pans: 24 inch (600 mm) downstream of coil and down spouts for cooling coil banks more than one coil high.
C. Eliminators: Three break of galvanized steel, mounted over drain pan.
D. Air Coils:
1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.
E. Fabrication:
1. Tubes: 5/8-inch (16 mm) OD seamless copper expanded into fins, brazed joints.
2. Fins: Aluminum.

3. Casing: Die formed channel frame of galvanized steel.

F. Refrigerant Coils:
1. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
2. Headers: Seamless copper tubes with silver brazed joints.
3. Liquid Distributors: Brass or copper venturi distributor with seamless copper distributor tubes.
4. Configuration: Down feed with bottom suction.

G. Electric Coils:
1. Assembly: UL (DIR) listed and labeled, with terminal control box and hinged cover, splice box, coil, casing, and controls.
2. Coil: Enclosed copper tube, aluminum finned element.
3. Casing: Die formed channel frame of galvanized steel.
4. Controls: Automatic reset thermal cut-out, built-in magnetic contactors control circuit transformer and fuse.

2.05 INTEGRAL FACE AND BYPASS COIL SECTION

A. Enclose headers and return bends within unit casing.
B. Assembly to consist of finned heating elements and bypasses with interlocked dampers.
C. Provide factory damper actuator.

2.06 FILTER AND AIR CLEANER SECTION

A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.
B. Pleated Media Filters:
Media: 2 inch (50 mm), 100 percent synthetic fibers, continuously laminated to a grid with water repellent adhesive, and capable of operating up to a maximum of 625 fpm (3.17 m/s) without loss of efficiency and holding capacity.
1. Frame: Steel wire grid.
2. Minimum Efficiency Reporting Value: 13 MERV when tested in accordance with ASHRAE Std 52.2.

C. Bag Filters:
1. Media: 2 inch (50 mm), pleated, 8 MERV prefilter with fine-fiber, fiberglass bag filter, sealed into gasketed, metal headers, and capable of operating up to a maximum of 625 fpm (3.17 m/s) for without loss of efficiency and holding capacity.
2. Filter Rack: Side-access rack designed to hold the metal headers.
3. Minimum Efficiency Reporting Value: 13 MERV when tested in accordance with ASHRAE Std 52.2.

D. Hi-Efficiency Filters:
1. Media: 2 inch (50 mm) prefilter and 4 inch (305 mm) closely spaced, pleated, fine fiber, hi-efficiency filter, sealed into a rigid frame, and capable of operating up to a maximum of 625 fpm (3.17 mps) without loss of efficiency and holding capacity.
2. Filter Rack: Side-access designed to hold rigid frames.
3. Minimum Efficiency Reporting Value: 13 MERV when tested in accordance with ASHRAE Std 52.2.

E. HEPA Filters:
1. Media: Continuously pleated, waterproof, micro-fiberglass; enclosed in a galvanized, steel frame with neoprene rubber seal applied to leaving air side, and capable of operating up to a maximum of 625 fpm (2.54 mps) without loss of efficiency and holding capacity.
2. Frame: Continuously welded, gasketed, front loaded filter frames, mounted inside section casing along with filter holding clips, requiring tooling to tighten and hold filter cells.
3. Minimum Efficiency: Not less than: 99.97 percent when tested in accordance with ASHRAE Std 52.2.

F. Differential Pressure Gauge:
1. Provide factory installed dial type differential pressure gauge, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.
2. Maintain plus/minus 5 percent accuracy within operating limits of 20 degrees F (minus 6.7 degrees C) to 120 degrees F (48.9 degrees C).

2.07 DAMPER SECTION

A. Mixing Section: Provide a functional section to support the damper assembly for modulating the volume of outdoor, return, and exhaust air.
B. Internal Face and Bypass Section: Provide dampers to divert airflow around the heating and cooling coils.
C. Internal Face Damper Section: Provide as indicated within the air handling unit.
D. Damper Blades:
    1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
    2. Self-lubricating stainless steel or synthetic sleeve bearings.
    3. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
    4. Provide leakage testing and pressure ratings in compliance with AMCA 500-D test methods.
    5. Arrange in parallel or opposed-blade configuration.

E. Barometric Relief Dampers:
    1. Frame: Roll formed galvanized steel.
    2. Blades: Roll formed galvanized steel.
    3. Blade Seals: Extruded vinyl, mechanically attached to the blade edge.
    4. Material:
        a. Galvanized steel, single tie bar linkage for damper sections up to 24 inches (610 mm) wide.
        b. Stainless steel, single tie bar linkage for damper sections larger than 24 inches (610 mm) wide.
        c. Synthetic axle assembly mechanically locked onto blade edge for damper sections up to 42 inches (1067 mm).
        d. Stainless steel axle and blade bracket assembly for damper sections larger than 42 inches (1067 mm) wide.

2.08 AIRFLOW MEASUREMENT

A. Flow Meter:
    1. Provide airflow measurement system to directly measure fan airflow or measure differential pressure that can be used to calculate airflow without interfering with submitted airflow performance and noise levels.
    2. Accuracy: Plus/minus 5 percent (device and transmitter) when operating within the stable operating region of the fan curve.
B. Air Flow Measurement Station:
    1. Provide factory installed, airflow measurement station tested in accordance with AMCA 611 and bearing the AMCA Ratings Seal for Airflow Measurement Performance.
    2. Station Location: Install in outdoor, return, and exhaust opening to measure airflow.
    3. Damper Blades:
        a. Galvanized steel or extruded aluminum construction.
        b. Housed in galvanized steel or extruded aluminum frame and mechanically fastened to a rotating axle rod.
        c. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
    4. Measurement Range: Minimum of 15 percent to 100 percent of unit nominal flow.
    5. Operation: Provide low voltage signal corresponding to actual airflow for controlling and documenting airflow.
    6. Accuracy: Plus/minus 5 percent.

2.09 TOTAL ENERGY RECOVERY WHEEL SECTION

A. Certified in accordance with AHRI 1060 (I-P) and UL 1812 for mechanical, electrical, and fire safety.
B. Wheel Construction:
    1. Dessicant Properties:
        a. Factory coated.
        b. Washable using standard detergent or alkaline based coil cleaner.
        c. Resistant to high levels of humidity.
    2. Factory set adjustable diameter seals and self-adjusting perimeter seals.

3. Permanently sealed and lubricated wheel bearings.
4. Motor:
    a. Thermally protected.
    b. Factory mounted.

C. Maintenance and Access Features:
1. Access doors upstream and downstream of the wheel cassette.
2. Removable wheel segments to facilitate maintenance and cleaning.
3. Adequate space for cleaning, service, and maintenance.

D. Controls:
1. Wheel Control: Damper control of recovery capacity to 40 percent of initial total recovery capacity.
2. Frost Prevention Control: Provide outside air bypass, return air preheat, or variable speed.

2.10 ULTRAVIOLET LIGHTS

A. Tested and recognized by UL 153, UL 1598 and UL 1995 for luminaries, heating, and cooling equipment.
B. UV-C (Short Wave) Light Array Performance: Provide not less than 1250 microwatts per sq inch.
C. Construction:
1. Factory assemble and test UV-C fixtures in the air handling unit.
2. Materials:
    a. Provide UV-C resistant polymeric materials or shield from direct or indirect UV-C light with UV-C tolerant material.
    b. UV-C Fixtures: Stainless steel to resist corrosion.
3. Lamp Life: 9000 hrs minimum with no more than 20 percent loss of output after two years of continuous use.
4. Mount UV-C fixtures on slide-out rack to enable servicing from unit exterior via access door.
5. View Port: Provide with cover to allow viewing of the UV-C light array.

D. Safety Features:
1. Treat view port and other windows to assure the UV-C energy emitted is below the threshold limit specified by American Conference of Governmental Industrial Hygienists (ACGIH).
2. Provide a mechanical interlock switch to disconnect power to the UV-C fixtures when the opening of an access door may pose an exposure risk to UV-C light.
3. Provide externally mounted, on-off, disconnect, and shutoff switch with lockout/tagout that disconnects UV-C power and prevents unwanted operation of UV-C lights.

2.11 AIR CLEANING SYSTEMS

A. High Efficiency Particle Filtration:
1. Minimum Efficiency Reporting Value (MERV): 13 or higher.
2. Position upstream of the Ultraviolet Germicidal Irradiation (UVGI) and the Photocatalytic Oxidation (PCO) catalyst media.

B. (UVGI) Lamps and Ballasts:
1. Provide type C ultraviolet light with a wavelength at or near 253.7 Angstroms without producing ozone.
2. Imbed lamps in the center of the catalyst media bank.
3. Minimum Coverage: 5 milliwatts per sq in (0.775 milliwatts per sq cm) of UV-C light across exposed surfaces of the PCO media.
4. Comply with UL 1995.

C. Photocatalytic Oxidation (PCO) Catalyst Media:
1. Construction:
    a. Provide 6 inch (183 cm) deep grid, in direction of airflow with face area to match casing opening.
    b. Closely spaced pleats coated with (0.00157 - 0.00787) mil ((40 - 20) nanometer) thick titanium dioxide (TiO2).
    c. House complete assembly in a galvanized steel casing, perpendicular to the airflow.
2. Maintenance and Safety Features:
    a. UV lamps and PCO media removable through side access door of AHU casing.
    b. Wire airflow switch into control circuit to disable UV lights when the air handling unit fan

is not running.
c. Treat view port to assure the UV-C energy emitted is below the threshold limit specified by ACGIH.
d. Provide mechanical interlock switch to disconnect power to the UV-C fixtures when the opening of an access door may pose an exposure risk to UV-C light.
e. Provide externally mounted, on-off, disconnect, and shutoff switch with lockout/tagout that disconnects UV-C power and prevents unwanted operation of UV-C lights.
f. Affix safety warning label to the exterior of each section containing UC-C lights.
3. Polymeric Materials: Provide UV-C resistant polymeric materials or shield from direct or indirect UV-C light with UV-C tolerant material.

D. Electrical:
1. Provide independent single point external power connection.
2. Provide main fusing as necessary.
3. Provide UL 508 listed panel for power distribution and over-current protection for line voltage applications.

2.12 INDIRECT-FIRED GAS HEAT SECTION

A. Comply with UL 795 and CGA 3.2 for commercial-industrial gas heating equipment and CGA 3.2 for industrial gas-fired packaged furnaces.
B. Construction:
1. Factory assemble and fire test prior to shipment.
2. Burner Vestibule Materials and Components:
a. Heat Exchanger Assembly: 14 gage, 0.0747 inch (1.90 mm), 409 stainless steel.
b. Burner: UL (DIR) listed, forced draft, and fully modulating.
c. Control Panel: Equip with flame management controls and appropriate safeties.
d. Section construction same as rest of air handling unit with large access door.

2.13 MULTIZONE SECTION

A. Two-Deck Multizone:
1. Provide cooling coil in the lower deck and heating coil in the upper deck.
2. Pressure drop equalization baffles balance air pressure drop through each deck.
3. Multizone Damper Construction:
a. Double-skin airfoil design.
b. Metal, compressible jamb seals.
c. Extruded vinyl edge seals on each blade.
d. Stainless steel ball bearings.
e. Maximum Damper Leakage: 11 cfm per sq ft (0.05588 L/s per sq m) at 1.0 inch w.g. (248 Pa).

B. Three-Deck Multizone:
1. Provide cooling coil in the lower deck, heating coil in the upper deck, and a bypass (neutral) center deck.
2. Pressure drop equalization baffles balance air pressure drop through each deck.
3. Multizone Damper Construction:
a. Double-skin airfoil design.
b. Metal, compressible jamb seals.
c. Extruded vinyl edge seals on blades.
d. Stainless steel ball bearings.
e. Maximum Damper Leakage: 11 cfm per sq ft (0.05588 L/s per sq m) at 1.0 inch w.g. (248 Pa).

C. Double-Deck Multizone:
1. Provide cooling coil in the lower deck and heating coil in the upper deck.
2. Pressure drop equalization baffles balance air pressure drop through each deck.

D. Triple-Deck Multizone:
1. Provide cooling coil in the lower deck, heating coil in the upper deck, and a bypass (neutral) center deck.
2. Pressure drop equalization baffles balance air pressure drop through each deck.

2.14 SILENCER SECTION

A. Provide rectangular silencer(s) to reduce airborne sound transmitted through the air handling

unit.

1. Comply with ASTM E477 for forward or reverse flow of air and noise in same or opposite directions in accordance with project requirements.
2. Factory test silencer(s) as an appurtenance with sufficient number of test points to validate performance over the full operating range in accordance with AHRI 260.

2.15 ACCESS SECTION

A. Provide where indicated on drawings to allow for inspection, cleaning, and maintenance of field-installed components.
B. Construct access doors same as previously specified within this Section.

2.16 AIR BLENDER SECTION

A. Provide factory engineered air mixers incorporating fixed blades with no moving parts.
B. Construction:
   1. Material: 0.80 inches (20.32 mm) aluminum, galvanized steel, aluminized steel, or stainless steel.
   2. Welded and mechanically fastened.
   3. Finish: Galvanized.
C. Factory install with adequate distances upstream and downstream, based on cataloged performance with a minimum, effectiveness of 70 percent outside air or within plus/minus 6 degrees F (2.73 degrees C) of theoretical mixed air temperature, at a minimum distance of one mixer diameter downstream of the mixer.
D. Include pressure loss due to mixer design and mixer-to-plenum ratio in the pressure drop rating for the static air mixer.

2.17 DIFFUSER SECTION

A. Provide diffuser section immediately after fan section.
B. Diffuser provides equal air distribution to blow-thru components immediately downstream of the diffuser.

2.18 TURNING AND DISCHARGE PLENUM SECTION

A. Provide plenum to efficiently turn and discharge air.
   1. Scale plenum vertical height to accommodate discharge duct height.
   2. Scale plenum horizontal length to accommodate required dimensional constraints.
B. Acoustical Liner:
   1. Fabricate from corrosion-proof, perforated stainless steel with completely encapsulated fiberglass insulation.
   2. Prevent breakaway, flake off, or delamination when tested at 9000 fpm (45.7 m/sec) in accordance with UL 181.

2.19 CONTROLS

A. Combination Starter-Disconnects:
   1. Provide combination starter-disconnect for each fan motor.
   2. Factory mount in full metal enclosure and wire to fan motor.
   3. Mount starter-disconnect on fan section externally in a NEMA 1 enclosure within a dedicated controls section or housed fan section.
      a. Internal Enclosure Construction Characteristics:
         1) Integral part of unit casing to allow for thermal venting to casing interior.
         2) Accessible from unit exterior via access door.
         3) Construction of access doors same throughout unit.
   4. Include circuit breaker disconnect with through-the-door interlocking handle for externally mounted starters, spring loaded, and designed to rest only in the full and lockable ON or OFF state.
   5. Allow enclosure entry via a concealed defeater mechanism when the handle is in the ON position.
   6. Include the following items:
      a. Hand-Off-Auto (H-O-A) switch.
      b. Two normally open auxiliary contacts.
      c. Overload heaters.
      d. Manual reset overloads.
      e. 120V control transformer with fusing and secondary grounding.

7. Include power wiring from the starter control transformer to the secondary control system transformers, and start-stop wiring from the direct digital controller start-stop relay to the starter H-O-A switch.

B. Combination VFD - Disconnects:
   1. Provide factory mounted, combination VFD - disconnect for each fan motor.
   2. Factory mount in full metal enclosure and wire to fan motor.
   3. Mount VFD-disconnect on fan section externally in a NEMA 1 enclosure within a dedicated controls section or housed fan section.
      a. Internal Enclosure Construction Characteristics:
         1) Integral part of unit casing to allow for thermal venting to casing interior.
         2) Accessible from unit exterior via access door.
         3) Construction of access doors same throughout unit.
   4. Include circuit breaker disconnect with through-the-door interlocking handle for externally mounted starters, spring loaded, and designed to rest only in the full and lockable ON or OFF state.
   5. Allow enclosure entry via a concealed defeater mechanism when the handle is in the ON position.
   6. Include control transformer with sufficient capacity to support the following items:
      a. VFD and controls.
      b. Binary output on-off wiring.
      c. Analog output speed-signal wiring.
      d. Wires that interface between VFD and direct digital controller.
   7. Mount starter on fan section externally in a NEMA 1 enclosure within a dedicated controls section or housed fan section.
      a. Internal Enclosure Construction Characteristics:
         1) Integral part of unit casing to allow for thermal venting to casing interior.
         2) Accessible from unit exterior via access door.
         3) Construction of access doors same throughout unit.
   8. Provide bypass relays and bypass circuitry with VFD-OFF-BYPASS selector switch.

C. Factory Installed Direct Digital Control (DDC) System:
   1. Factory engineer and test each component.
   2. Provide fully functional control system to operate in either stand-alone mode or as part of the building automation system (BAS) via single pair of twisted wires tie-in.
   3. DDC Controller:
      a. Dedicated, field programmable DDC controller with appropriate point capabilities.
      b. Portable Screen and Keypad Capabilities:
         1) Local monitoring.
         2) Troubleshooting.
         3) Setpoint adjustments.
         4) Physical plugging compatibility into other factory-configured controllers by same manufacturer.
   4. Control Options:
      a. Electronic End Devices:
         1) Accommodate integration into existing building systems.
         2) Wire to standard point locations of unit mounted DDC controller or terminal block for remote controller.
      b. Mixing Section Spring Return Damper Actuators:
         1) Outdoor Air Damper: Normally closed.
         2) Return Air Damper: Normally open.
      c. Air Flow Measurement Stations: 2 to 10 VDC signal corresponding to CFM for controlling and documenting airflow.
      d. Fan Discharge Temperature and Temperature Averaging Sensors: Suitable for integration into the BAS system.
      e. Low Limit Switches:
         1) Factory wire to momentary push-button reset circuit.
         2) Provide separate low limit for each coil in a coil stack.

f. Airflow Switches: Pipe to both filter sides to indicate fan status.
g. Dirty Filter Switches: Pipe to both filter sides to indicate filter status.
h. Condensate Overflow Switches:
1) Comply with UL 508.
2) Factory install float switch in drain pan to detect high water condensate level.
3) Shut down air handling unit in the event of primary drain blockage.
4) Locate float switch above primary drain line connection and below drain pan rim.
i. Provide Relays for each Binary Output of Controller for User Interface of the following:
1) Motor starters for supply, return, and exhaust fans.
2) Relief dampers.
3) Pumps.
4) Condensing units.

D. Factory Provided Controls for Field Installation:
1. Control valves.
2. Space and outdoor air temperature sensors.

2.20 ROOF MOUNTING CURB

A. Roof Vibration Isolation Mounting Curb: 24 inches (610 mm) high galvanized steel, channel frame with gaskets and nailer strips.
B. Include roof curb accessories for each roof mounted unit.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Bolt sections together with gaskets.
C. Isolate fan section with flexible duct connections.
D. Install flexible duct connections between fan inlet and discharge ductwork and air handling unit sections. Ensure that metal bands of connectors are parallel with minimum one inch (25 mm) flex between ductwork and fan while running.
E. Install assembled unit on vibration isolators. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining snubbers as indicated. Refer to Section 22 0548. Adjust snubbers to prevent tension in flexible connectors when fan is operating.
F. Provide fixed sheaves required for final air balance.
G. Make connections to coils with unions or flanges.
H. Hydronic Coils:
1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
3. Locate water supply at bottom of supply header and return water connection at top.
4. Provide manual air vents at high points complete with stop valve.
5. Ensure water coils are drainable and provide drain connection at low points.

I. Steam Coils:
1. Install vacuum breaker in steam line at or in header.
2. Install steam traps with outlet minimum 12 inches (300 mm) below coil return connection.

J. Refrigerant Coils: Provide sight glass in liquid line within 12 inches (300 mm) of coil.
K. Insulate Coil Headers Located Outside Air Flow as Specified for Piping: Refer to Section 23 0719.
L. Electric Duct Coils:
1. Wire in accordance with NFPA 70.

M. Connect Humidifiers to Water Supply:
1. Provide gate valve on water supply line.
2. Provide 3/4-inch (20 mm) hose bibb accessible from interior.
3. Pipe drain and overflow to nearest floor drain.

N. Bolt Humidifier Pump Directly to Tank Fitting:
1. Provide globe valve and solenoid valve in 1/2-inch (15 mm) bleed line from drain.
2. Provide low water cut-off in drain pan to stop spray pump.

O. Field-wire each factory provided control for field installation.

DIVISION 23 76 00 – PACKAGED OUTDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged roof top unit.
B. Unit controls.
C. Remote panel.
D. Roof mounting curb and base.
E. Maintenance service.

1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment; 2015, with Addendum (2016).
C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
C. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
D. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
E. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.
F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Extra Filters: One set for each unit.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

1.06 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.
B. Provide a five-year warranty to include coverage for refrigeration compressors.
    1. Provide a 15-year heat exchanger parts warranty, 5-year complete units parts warranty, and 1-year manufacturer labor warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Trane, a brand of Ingersoll Rand: www.trane.com.
B. York International Corporation/Johnson Controls Inc: www.johnsoncontrols.com.
C. Daikin: www.daikin.com
D. Lennox: www.lennox.com
E. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Heat Pump Heating:

1. Rated Outdoor Air Temperature: 17 degrees F (-8.8 degrees C) DB and 15 degrees F (-9.4 degrees C) WB.
2. Rated Air Temperature Entering Indoor Coil: 70 degrees F (21 degrees C).

B. Cooling Capacity:
1. Condenser Ambient Air: 95 degrees F.

C. Scheduled Performance:
1. Cooling Capacity: AHRI 210/240 test conditions.
2. Heat Pump Capacity:
   a. Rated Outdoor Air Temperature: 17 degrees F (-8.8 degrees C) DB and 15 degrees F (-9.4 degrees C) WB.
   b. Rated Air Temperature Entering Indoor Coil: 70 degrees F (21 degrees C).
3. Sound Rating Numbers: AHRI 270.

2.03 MANUFACTURED UNITS

A. General: Roof mounted units having gas burner and electric refrigeration.

B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, return fan, heat exchanger and burner, heat recovery coil, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.

C. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.

D. Electrical Characteristics:
1. Refer to *Division 26 05 83*.

E. Disconnect Switch: Factory mount disconnect switch in control panel.

2.04 FABRICATION

A. Cabinet: Steel with baked enamel finish, including access panels with screwdriver operated flush cam type fasteners. Structural members shall be minimum 18 gage, 0.0478 inch (1.21 mm), with access doors or panels of minimum 20 gage, 0.0359 inch (0.91 mm).

B. Insulation: one inch (25 mm) thick neoprene coated glass fiber with edges protected from erosion.

C. Insulation: 2 inch (50 mm) thick neoprene coated glass fiber with edges protected from erosion.

D. Heat Exchangers: Aluminized steel, of welded construction.

E. Supply and Return Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch motor pulley, and rubber isolated hinge mounted high efficiency motor or direct drive as indicated. Refer to *Division 22 05 48*.

F. Supply and Return Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch pulley, and rubber isolated hinge mounted high efficiency motor or direct drive as indicated. Isolate complete fan assembly. Refer to Section 23 0548.

G. Roof Mounting Curb: 24 inches (610 mm) high galvanized steel, channel frame with gaskets, nailer strips.

2.05 BURNER

A. Gas Burner: Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off pilot.

B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and slight delay, allow gas valve to open.

C. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.

D. Supply Fan Control: Temperature sensor sensing bonnet temperatures and independent of burner controls, with provisions for continuous fan operation.

2.06 ELECTRIC HEATING COIL

A. Finned tube heating elements easily accessible with automatic reset thermal cut-out, built-in magnetic contactors, galvanized steel frame, control circuit transformer and fuse, manual reset thermal cut-out, airflow proving device, toggle switch (pilot duty), load fuses.

B. Controls: Start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with switch for continuous fan operation.

2.07 EVAPORATOR COIL

A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.
B. Provide capillary tubes or thermostatic expansion valves for units of 6 tons (21 kw) capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons (26 kw) cooling capacity and larger.

2.08 COMPRESSOR

A. Provide hermetic compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.
B. Five minute timed off circuit to delay compressor start.
C. Outdoor thermostat to energize compressor above 35 degrees F (2 degrees C) ambient.
D. Provide step capacity control by hot gas by-pass.
E. For heat pump units, provide reversing valve, suction line accumulator, discharge muffler, flow control check valve, and solid-state defrost control utilizing thermistors.

2.09 CONDENSER COIL

A. Provide copper tube aluminum fin coil assembly with subcooling rows and coil guard.
B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Provide high efficiency fan motors.
C. Provide refrigerant pressure switches to cycle condenser fans.

2.10 MIXED AIR CASING

A. Dampers: Provide outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper to fall to closed position. Relief dampers may be gravity balanced.
B. Gaskets: Provide tight fitting dampers with edge gaskets.
C. Gaskets: Provide tight fitting dampers with edge gaskets maximum leakage 5 percent at 2 inches (500 Pa) pressure differential.
D. Damper Operator, Units 7.5 Ton (26 kW) Cooling Capacity and Larger: 24 volts with gear train sealed in oil with spring return on.
E. Damper Operator: Pneumatic piston or gear driven type with spring return and pilot positioner.
F. Mixed Air Controls: Maintain selected supply air temperature and return dampers to minimum position on call for heating and above 75 degrees F (24 degrees C) ambient, or when ambient air temperature exceeds return air temperature.

2.11 OPERATING CONTROLS

A. Provide low voltage, adjustable room thermostat to control burner operation, compressor and condenser fan, and supply fan to maintain temperature setting.
    1. Include system selector switch (heat-off-cool) and fan control switch (auto-on).
    2. Provide double acting thermostat with stage heating and stage cooling.
    3. Locate thermostat in room as shown.
B. Provide terminal strip on unit for connection of operating controls to remote panel by others. Control shall allow for multiple stages of heating and cooling.
C. Provide remote mounted fan control switch (on-auto).
D. Provide low limit thermostat in supply air to close outside air damper and stop supply fan.
E. Provide night control energized by central time clock to maintain lower thermostat setting, lock out refrigeration, close outside air damper and open return air damper, stop supply air fan, for night and unoccupied operation. Provide time delay to maintain outside air damper closed and return air damper open after switching to day and occupied operation.
F. Provide remote readout panels containing signal lights indicating system status, heating system failure, cooling system failure, and dirty filters; check switches proving signal light operations; system on-off switch, and cooling system on-off switch.
G. Provide in panel a manual 12-hour timer to override night control, remote damper control, low limit manual reset, and remote thermostat temperature set point.

2.12 OPERATING CONTROLS - SINGLE ZONE UNITS

A. Electric solid state microcomputer based room thermostat, located as indicated in service area with remote sensor located as indicated.
B. Room thermostat shall incorporate:
    1. Automatic switching from heating to cooling.

2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set-up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from one hour to 31 days.
5. Short cycle protection.
6. Programming based on weekdays, Saturday and Sunday.
7. Switch selection features including imperial or metric display, 12- or 24-hour clock, keyboard disable, remote sensor, fan on-auto.

C. Room thermostat display shall include:
1. Time of day.
2. Actual room temperature.
3. Programmed temperature.
4. Programmed time.
5. Duration of timed override.
6. Day of week.
7. System model indication: heating, cooling, auto, off, fan auto, fan on.
8. Stage (heating or cooling) operation.

D. Provide low limit thermostat in supply air to close outside air dampers and stop supply fan.

2.13 OPERATING CONTROLS - VARIABLE VOLUME UNITS

A. Temperature transmitter located in supply air shall signal electronic logic panel to control mixing dampers and cooling in sequence. Mixing section shall operate as first stage of cooling and revert to minimum outside air above approximately 75 degrees F (24 degrees C) as determined by enthalpy of return and outdoor air.
B. Control cooling by cycling compressors, cylinder unloading, and hot gas bypass.
C. Control logic shall allow supply air reset under low load or airflow conditions.
D. Seven-day time clock with spring carry over (or electronic clock with battery backup) shall control unit on occupied/un-occupied schedule. At night, unit shall be off. Locate clock in remote control panel with status lights.
E. Provide two stage morning warm-up thermostat to hold outdoor dampers closed and energize heat until return air temperature reaches set point.
F. Provide within roof curb, by-pass dampers, bypassing air from supply fan discharge to return fan inlet to control duct static pressures. Control operation by sensing current to supply fan motor.

2.14 HEAT RECOVERY COIL

A. Provide copper tube aluminum fin coil assembly with multiple circuits arranged to provide heat recovery.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.
B. Verify that proper power supply is available.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install in accordance with NFPA 90A.
C. Mount units on factory-built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.
D. Locate remote panels where indicated on drawings.

3.03 SYSTEM STARTUP

A. Prepare and start equipment. Adjust for proper operation.

3.04 CLOSEOUT ACTIVITIES

A. Demonstrate operation to Owner's maintenance personnel.

3.05 MAINTENANCE

A. See *Division 01 70 00* - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
B. Provide a separate maintenance contract for specified maintenance service.
C. Provide service and maintenance of packaged roof top units for one year from Date of Substantial Completion.
D. Provide routine maintenance service with a two-month interval as maximum time period between

calls.

E. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibration.
F. Provide 24-hour emergency service on breakdowns and malfunctions.
G. After each service call, submit copy of service call work order or report that includes description of work performed.

DIVISION 23 79 00 – DEDICATED OUTDOOR AIR UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Service platform.
B. Controls.

1.02 RELATED REQUIREMENTS

A. *Division 22 05 13* - Common Motor Requirements for Plumbing Equipment.
B. *Division 22 05 48* - Vibration and Seismic Controls for Plumbing Piping and Equipment.
C. *Division 23 00 00* - Common Motor Requirements for HVAC Equipment.
D. *Division 23 05 00* - Vibration and Seismic Controls for HVAC.
E. *Division 23 33 00* - Air Duct Accessories: Flexible duct connections.
F. *Division 23 34 00* - Centrifugal HVAC Fans: Supply fans.
G. *Division 23 40 00* - HVAC Air Cleaning Devices: Filters.

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data with dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.
C. Shop Drawings: Indicate dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.
D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
E. Operation And Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
F. Warranty: Submit manufacturer’s warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Extra Filters: One set of each type and size.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
B. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience and approved by manufacturer.

1.06 REGULATORY REQUIREMENTS

A. Conform to NFPA 70.
B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.07 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.
B. Provide five-year manufacturer’s warranty for compressor/condenser unit.
    1. Provide a 15-year heat exchanger parts warranty, 5-year complete units parts warranty, and 1-year manufacturer labor warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Greenheck: www.greenheck.com.

B. I.C.E. (Industrial Commercial Equipment Manufacturing Ltd.): www.ice-ww.com.
C. Applied Air/Mestek Technology, Inc: www.appliedair.com.
D. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 FABRICATION

A. Casing and Components: Steel panels, 18 gage, 0.0478 (1.21 mm) reinforced with structural angles and channels to ensure rigidity; access panels to burner and blower motor assemblies from either side of unit.
B. Observation Port: On burner section for observing main and pilot flames.
C. Insulation: Neoprene faced glass fiber insulation 1 inch (25 mm) thick on inlet components to burner profile plate.
D. Finish: Heat resistant baked enamel.
E. Suspended Installations: Service platforms complete with handrails and access ladder.
F. Outdoor Installation: Weatherproofed casing, with intake louver or hood.

2.03 FILTERS

A. Filter: Removable 1 inch (25 mm) thick high velocity permanent filters in metal frames.
B. Filter: Removable 2 inches (50 mm) thick high velocity permanent filters in metal frames.

2.04 BURNERS

A. Assembly: For natural gas, capable of modulating turn down ratio of 25:1, including electric modulating main gas valve, motorized shut down valve, main and pilot gas regulators, pilot electric gas valve, manual shut-off valve and pilot adjustment valve.
B. Pilot: Electrically ignited by spark rod through high voltage ignition transformer.
C. Damper: Motorized with end switch to prove position before burner will fire.

2.05 FAN

A. Fan: Statically and dynamically balanced centrifugal fan mounted on solid steel shaft with heavy duty self-aligning pre-lubricated ball bearings and V-belt drive with matching motor sheaves and belts.
B. Electrical Characteristics:
    1. Refer to *Division 26 05 83*.

2.06 CONTROLS

A. Controls: Pre-wire unit for connection of power supply. Field wiring from unit to remote control panel makes unit operative.
B. Remote Control Panel: On-off-auto switch, summer-winter switch, heat-off-cool switch, indicating lights for supply fan, exhaust fan, pilot operation, burner operation, lockout indication, and clogged filter indication.
C. Timer: Operates fan system on low volume at night.
D. Safety Controls: Sense correct air flow before energizing pilot and sense pilot ignition before activating main gas valve.
E. Manual Reset Low and High Limit Controls: Maintain supply air temperature between set points and shut fan down if temperatures are exceeded.
F. Purge Period Timer: Automatically delays burner ignition and bypass low limit control.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install to NFPA 90A.
C. Install unit on vibration isolators; refer to *Division 22 05 48*.
D. Install unit on vibration isolators; refer to *Division 23 05 00*.
E. Provide flexible duct connections on inlet and outlet from unit; refer to *Division 23 33 00*.

3.02 MAINTENANCE

A. See *Division 01 70 00* - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
B. Provide a separate maintenance contract for specified maintenance service.
C. Provide service and maintenance of units for one year from Date of Substantial Completion.

DIVISION 23 80 00 – UNIT VENTILATORS

GENERAL

Units shall have ECM supply fan and condenser motor with stainless steel drain pan. Provide 5-year parts warranty and manufacturer startup.

Provide control valve per Design Engineer either 2-way/3-way or face/bypass damper. Provide factory or field BACnet DDC controller.

Provide wall mounted sensor with fan speed, override, set point adjust, and display with guard. Provide new wall sleeve, outdoor air louver and relief damper.

Valve pack shall have circuit setter, control valve, isolation valves, y-strainer with blow out valve, P/T ports. All water coils shall have stainless steel coil casing and drain pan.
MSCS prefers self-contained unit ventilators to have 2-stage scroll compressors with thermal expansion valves
and medium or high-pressure refrigerant without a phaseout date. VFD compressors with electronic expansion
valve are not recommended and will be reviewed on a case-by-case basis.

Designer, Engineer-of-Record, and contractor shall confirm and verify wall openings to ensure correct sizing.
Designer, Engineer-of-Record, and contractor shall provide all modifications to the wall openings to ensure weather-tightness to prevent moisture intrusion and any impacts to the unit performance. When openings are required to be larger than the existing opening, the Engineer-of-Record shall provide a detail to ensure structural integrity and weather-tightness to prevent moisture intrusion and any impacts to the unit performance.

Provide bipolar needlepoint ionizers with self-cleaning function and meet the UL-2998 non-ozone certificate criteria and 3-year warranty. Designers may use the manufacturer, GPS, as a basis of design.

The manufacturer shall provide factory training for two eight-hour sessions on service and maintenance class for up to 10 MSCS HVAC technicians. One at the close of the project and the second later. Coordinate training dates with MSCS. This is in addition to the walk-through training at the school.

DIVISION 23 82 00 – SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air-source heat pumps.
B. Forced air furnaces.
C. Air cooled condensing units.
D. Indoor air handling (fan and coil) units for ducted systems.
E. Indoor air handling (fan and coil) units for ductless systems.
F. Controls.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Mounting pad for outdoor unit.
B. *Division 22 10 05* - Plumbing Piping: Includes Plumbing Piping: Includes indoor coil condensate drain, water supply for humidifier.
C. *Division 22 30 00* - Plumbing Equipment: Cooling condensate removal pumps.
D. *Division 23 31 13* - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment; 2015, with Addendum (2016).
C. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
D. AHRI 610 (I-P) - Performance Rating Of Central System Humidifiers for Residential Applications;

2014.
E. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Addendum (2024).
F. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.
G. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. NEMA MG 1 - Motors and Generators; 2014.
I. NFPA 54 - National Fuel Gas Code; 2024.
J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
K. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2021.
L. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2024.
M. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
D. Design Data: Indicate refrigerant pipe sizing.
E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Extra Filters: One for each unit.
    3. Extra Pilot Thermocouples: One for each unit.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience and approved by manufacturer.

1.06 WARRANTY

A. See *Division 01 80 00* - Closeout Submittals, for additional warranty requirements.
B. Provide three-year manufacturer’s warranty for solid state ignition modules.
C. Provide five-year manufacturer’s warranty for heat exchangers.
D. Provide five-year manufacturer’s warranty for electronic air cleaners.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Trane Inc: www.trane.com.
B. Daikin: www.daikin.com.
C. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 SYSTEM DESIGN

A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
    1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator; auxiliary electric heat.
    2. Heating: Natural gas fired.
    3. Heating: None.
    4. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.
    5. Provide refrigerant lines internal to units and between indoor and outdoor units, factory

cleaned, dried, pressurized and sealed, with insulated suction line.

B. Performance Requirements: See Drawings for additional requirements.
   1. Efficiency:
      a. Comply with ASHRAE Std 90.1.

C. Electrical Characteristics:
   1. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of *Division 26 05 83*.

2.03 INDOOR AIR HANDLING UNITS FOR DUCTED SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.
   1. Air Flow Configuration: Counterflow with additional steel base.
   2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.

B. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.
   1. Motor: NEMA MG 1; 1750 rpm single speed, permanently lubricated, hinge mounted.

C. Air Filters: MERV-13.

D. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
   1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
   2. Manufacturers: System manufacturer.

2.04 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
   1. Location: Ceiling/wall.
   2. Sound Rating:
   3. Cabinet: Galvanized steel.
      a. Finish: White.
   4. Fan: Line-flow fan direct driven by a single motor.
   5. Filter return air with washable, antioxidant pre-filter and a pleated anti-allergy enzyme filter.

B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
   1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
   2. Manufacturer: System manufacturer.

2.05 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
   1. Comply with AHRI 210/240.
   2. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
   3. Refrigerant: R-410A.
   4. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
   5. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.
   6. Sound Rating: 69 dBA, when measured in accordance with AHRI 270.

B. Compressor: Hermetic, two speed 1800 and 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.

C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

1. Condenser Fans: Direct-drive propeller type.
2. Condenser Fan Motor: Enclosed, 1-phase type, permanently lubricated.

D. Coil: Air-cooled, aluminum fins bonded to copper tubes.
E. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
1. Provide thermostatic expansion valves.
2. Provide heat pump reversing valves.
F. Operating Controls:
1. Control by room thermostat to maintain room temperature setting.
2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig (1965 kPa) and off when pressure drops below 140 psig (965 kPa) for operation to 0 degrees F (-18 degrees C).
G. Mounting Pad: Precast concrete parking bumpers, minimum 4 inches (100 mm) square; minimum of two located under cabinet feet.

2.06 GAS FURNACE COMPONENTS

A. Heat Exchanger: Aluminized steel ceramic coated clamshell type welded construction.
B. Heat Exchanger: Cast iron combustion chamber with stainless and aluminized steel tailpipe and decoupler, resiliently mounted.
C. Heat Exchanger: Aluminized and stainless steel tubular type.
D. Coating: Polypropylene.
E. Insulation: Foil-faced.
F. Burner: Atmospheric type with adjustable combustion air supply,
1. Gas valve, two stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
2. Electronic pilot ignition, with electric spark igniter.
3. Combustion air damper with synchronous spring return damper motor.
4. Non-corrosive combustion air blower with permanently lubricated motor.
G. Burner Safety Controls:
1. Thermocouple Sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
2. Flame Rollout Switch: Installed on burner box and prevents operation.
3. Vent Safety Shutoff Sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.
H. Operating Controls:
1. Cycle burner by room thermostat to maintain room temperature setting.
2. Supply fan energized from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation.
3. Provide continuous low speed fan operation.
I. Flue Termination: Standard roof kit.

2.07 ELECTRIC FURNACE COMPONENTS

A. Electric Heater: Helix wound bare nichrome wire heating elements arranged in incremental stages of 5 kW each, with porcelain insulators.
B. Operating Controls:
1. Heater stages energized in sequence with pre-determined delay between heating stages.
2. High limit temperature control to de-energize heating elements, with automatic reset.
3. Supply fan started before electric elements are energized and continues operating after thermostat is satisfied until bonnet temperature reaches minimum setting. Include manual switch for continuous fan operation.
4. Outdoor thermostat lock-out of some heating elements until outdoor temperature drops.

2.08 ACCESSORY EQUIPMENT

A. Economizer Damper Units: Steel cabinet with baked enamel finish, easily removed and secured access doors, glass fiber insulation.
1. Dampers: Formed steel with nylon bearings and gaskets.

2. Damper Operator: 24 volt, three position spring return motor with adjustable minimum position switch.
3. Control Wiring: Provide wiring harness consisting of control board with relays, wiring harness, transformer, and hardware.
4. Controls: Discharge air thermostat, adjustable outdoor air "enthalpy" control, return air "enthalpy" sensor position dampers, and interface to room thermostat.

B. Room Humidistat: Electric, adjustable, to energize humidifier when fan operating, to maintain setting.

C. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
1. System selector switch (heat-off-cool) and fan control switch (auto-on).
2. Automatic switching from heating to cooling.
3. Preferential rate control to minimize overshoot and deviation from setpoint.
4. Set-up for four separate temperatures per day.
5. Instant override of setpoint for continuous or timed period from one hour to 31 days.
6. Short cycle protection.
7. Programming based on weekdays, Saturday and Sunday.
8. Selection features including degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, fan on-auto.
9. Battery replacement without program loss.
10. Thermostat Display:
    a. Time of day.
    b. Actual room temperature.
    c. Programmed temperature.
    d. Programmed time.
    e. Duration of timed override.
    f. Day of week.
    g. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.
11. Manufacturers:
    a. Daikin: www.daikin.com
    b. Siemens: www.siemens .com
    c. Trane Inc: www.trane.com.
    d. York International Corporation / Johnson Controls: www.york.com.
    e. Substitutions: See *Division 01 60 00* - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
B. Verify that proper power supply is available and in correct location.
C. Verify that proper fuel supply is available for connection.
D. Verify that water supply is available for humidifiers.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
B. Install in accordance with NFPA 90A and NFPA 90B.
C. Install gas fired furnaces in accordance with NFPA 54.
D. Provide vent connections in accordance with NFPA 211.
E. Install refrigeration systems in accordance with ASHRAE Std 15.
F. Install humidifiers in accordance with AHRI 610 (I-P) or AHRI 611 (SI).
G. Mount counterflow furnaces installed on combustible floors on additive base.
H. Pipe drain from humidifiers to nearest floor drain.

DIVISION 25 50 00 – ENERGY MANAGEMENT SYSTEM

GENERAL

The building Energy Management System shall comply with the following specifications and should describe a system to control the HVAC of the building for the purpose of minimizing energy usage while maintaining a comfortable environment for the occupants. Any new projects or renovations must include new and upgraded DDC controls for any new or existing HVAC equipment for the entire site.

ENERGY MANAGEMENT: The installation of a BACnet Stand-Alone Web Based "EMS" energy management system with the capability of being monitored REMOTELY by the Maintenance Department via a web browser utilizing any smart device or computer for each NEW facility shall be provided. The specified system should be capable of controlling all HVAC, water heating, exhaust fans and other mechanical-electrical systems in the building.

Any new IT drops or required Ethernet switches is the responsibility of the contractor.

All new DDC controls shall be BACnet open protocol and shall be a stand-alone web-based browser operating system. The system shall have a building edge device containing all required software, programming, and graphic data base to provide stand-alone building operation, and remote secure access via the Web and smart device APP. System shall be capable (FUTURE) of seamlessly integrating to MSCS' "SIEMENS DESIGO AUTOMATION" management level web server via Edge2Cloud, N-Haystack, and BACnet IP.

BAS Contractor to program and display outside air and supply air flows on equipment graphics. Points to be capable of being modified and trended for every AHU and RTU equipped with airflow measuring devices via BACnet.

The Engineer of Record shall follow the "MSCS" Standardized Sequence(s) of Operation for all newly installed equipment. (Please contact MSCS Facilities for these Standardized Sequence(s) of Operation as they are continually being updated).

The following Design Criteria are items that shall apply to the EMS design:

- *Discharge air temperature sensors shall be included in the design and not be value engineered.*
- *Exhaust fans must be disabled when mechanical system in UNOCCUPIED unless specific conditions require otherwise and MSCS is notified in advance of this condition.*
- *All controls valve mounted outdoors must be Nema-4X rated.*
- *Use conduit in mechanical rooms, outdoors, and spaces with hard ceilings.*

DIVISION 26 00 00 - ELECTRICAL REQUIREMENTS

PART 1 GENERAL

The following Design Criteria are general items that shall apply to the design of all Plumbing, HVAC, Electrical and Electronic Systems in the buildings.

The Engineer shall confirm the delivered voltage to the site by MLGW (480 volts) and specify equipment that will function within the full range of power provided by the electrical distributor (480 volts).
The Electrical Contractor on an HVAC project shall be charged with providing power to all energy management equipment requiring power of 96 volts or greater.

The location of all existing and proposed new EMS panels, DEMs and other EMS devices shall be shown on drawings and noted in specifications.

The Electrical Contractor on an HVAC project shall be charged with installing any high voltage device (96 volts of greater) provided by the energy management vendor, such as a digital energy monitor (DEM), if one or any are called for in the project documents.
The location of all existing and new EMS panels, DEMs and other EMS devices shall be shown on drawings and noted in specifications.

The location of all existing and new electrical panels shall be shown on drawings and noted in specifications. Remove and/or bypass any obsolete control systems.
Identify any existing controls that will be made obsolete by the new project and address, as necessary.

Exhaust fans must be disabled when mechanical system is UNOCCUPIED unless specific conditions require otherwise and MMSCS is notified in advance of this condition.

Emergency STOPS for mechanical equipment shall have hinged, non-lockable, clear, protective covers to prevent accidental shut-down.

Exhaust fans must be disabled when mechanical system is UNOCCUPIED unless specific conditions require otherwise and MMSCS is notified in advance of this condition.

SCIENCE CLASSROOMS: Provide a single emergency (mushroom type) shut-off switch in each science lab /classroom that will close valves in the gas, water source serving each particular science lab / classroom; (except that serving emergency showers and eye washes) and interrupt all power (excluding overhead lighting, exhaust systems and fume hood) serving the classroom. Devices used to interrupt the gas and water valves shall normally be closed devices, and devices used to interrupt the electrical power shall fail open. The emergency switch shall be highly visible, have a keyed reset and be readily accessible to the teacher but not easily reached by students. For gas systems, gas service remains off at all times unless activated by a 0-6-hour timed switch. Timed switch shall require a key access.

DESIGN REQUIREMENTS: In any building where future expansion is planned, as conveyed by Owner, the Designer shall provide adequate additional capacity and connection points in the Mechanical and Electrical Systems as directed by Owner. The additional capacity shall be clearly noted on the front sheet of the drawings. Provide four (4) 3/4" spare conduits for all recessed panelboards to stub out above ceilings.

The electrical contractor shall provide power wiring for each piece of mechanical equipment. The mechanical contractors are required to furnish all starters and disconnects and turn over to the electrical contractor for installation and to make final connections from slack wire left by electrical contractor to each piece of equipment. Show detail on drawing to avoid confusion.

All points for future connections shall also be clearly shown and labeled on the drawings with the capacity (GPM, Tons, kW, etc.) that is available for future at each connection point.
Where future additions are not planned or are unknown, 25% spare capacity, both electrical and physical shall be provided in the electrical service, all panelboards and related equipment after all known loads are included.

Do not locate pumps, motors, or other equipment requiring routine maintenance overhead.

All air handling equipment, pumps, motors, valves, etc., shall be mounted in areas easily accessible for routine maintenance. Provide code required manufacturer’s recommended or 3 feet clearance whichever is greater, around equipment for access to motors, compressors, bearings, controls, filters, valves, etc. Provide filter change space and coil pull space. Locate related equipment together, i.e., in the same room and on the same floor. Do not layout equipment rooms such that equipment, piping and/or ductwork must be removed to perform maintenance. Do not locate equipment overhead and above ceilings unless specifically approved by Owner.

Show dotted lines on floor plans of all mechanical rooms and all other heavily concentrated areas to designate pull spaces for equipment, (coils, motors, etc.) and maintenance space for equipment (filter change out, lubrication, belt replacement, bearing replacement, compressor replacement, valve maintenance, etc.).

Show a complete legend and symbol list on the first sheet all trades (Plumbing, HVAC, Electrical, etc.). Provide a detailed isometric scaled typical detail showing the equipment, and/or piping and the walls,

ceiling, and floor of the room, where terminal units and/or piping are to be installed exposed in classrooms, media centers, cafeterias, kitchens, administrative areas or other finished areas of the building.
Show complete piping schematic drawings for all piping systems.
Isometric piping diagrams shall be shown for all mechanical equipment used in the building showing all fittings, valves, thermometers, gauges, and other devices required for proper operations and isolation.

All mechanical and boiler rooms shall be shown at a scale of a minimum of 1/4" = 1'-0" and all equipment in the room including piping, drawn to scale with all clearances shown. Show all trades on the large-scale drawings. Show a minimum of two (2) sections through the rooms or show the room in a full isometric drawing. Show all door swings. Do not block access for any item of equipment with another.

Designers shall consider the implementation of a mechanical platform located above the main corridors of the highest floor to assist in minimizing roof penetrations. Access shall be through stairwells and door openings sized per largest piece of designed equipment. No ship ladder access will be allowed. If stairwells are determined not to be able to accommodate large equipment, Designer shall incorporate alternate access methods such as exterior hinged louvers with pulley system or breakaway walls.

All building heating loads (MBH), cooling loads (tons), domestic hot and cold water demand (GPM), waste load (fixtures units), connected electrical loads (kW), gas loads (CFH), a list of "U" valves and an estimated maximum electrical demand (kW) shall be clearly shown in tabular form on the front sheet of the P/M/E drawings.
All capacities provided for future building additions shall also be shown in this table.

Show all mechanical and electrical equipment to scale including panelboards, fire alarm panels, sound panels, water heaters, etc.

CONSTRUCTION DOCUMENTS: The drawings for construction must include the following statement: All required documentation regarding the design of fire detection, alarm, and communications systems and the procedures for maintenance, inspection, and testing of fire detection, alarm, and communications systems shall be maintained at an approved, secured location for the life of the system.

SPECIFICATIONS: Show a list of acceptable manufacturers for all items of equipment specified. Refer to this document or if uncertain, consult with the Owner. Specify maximum noise levels for each item of equipment specified. Note: Do not locate noisy equipment near noise sensitive areas of the building. Equipment inside building shall not exceed 50 dB (decibel levels).
Engineer shall not locate noisy outdoor equipment (i.e.; chillers, cooling towers, etc.) near adjacent property owners which might result in complaints from the adjacent neighbors.

Specify minimum energy efficiency for each item of mechanical and electrical equipment based on it. For a water chiller, specify the minimum efficiency at the 25, 50, 75, and 100% operating conditions.
Specify that the Owner shall employ the services of an AABC or NEBB Certified Test and Balance Contractor to balance all air and water systems.

Specify that all belt driven equipment shall be provided with a spare belt to be turned over to the Maintenance Department.

Specify that all warranties shall commence from the date of Substantial Completion, not from the start-up date of the equipment.

Specify that three (3) complete electronic sets of operation and maintenance manuals on an electronic transfer device, such as a flash drive, shall be delivered to the Owner through the Designer before the Substantial Completion inspection is held.

All electrical systems' main service equipment and panel boards shall be designed with 25% minimum spare capacity, both physically and electrically, for future growth capabilities.

Provide lightning and surge suppression on all security, intercom, energy management system, CCTV, and fire alarm systems.

Provide transient voltage surge suppression for main electrical switchboard and all branch circuit panel boards serving computers and electronic loads.

Provide phase loss protection at electrical panels serving HVAC motors and compressors.
Electrical Contractor shall provide dedicated and protected 120V power to all HVAC control panels and damper operators. Provide a junction box and an on/off service switch directly over the control panel.

The O&M CD shall be submitted digitally and formatted per the MSCS close out manual index.

1.01 RELATED DOCUMENTS

A. Drawings and the General Conditions, Instructions and all other general requirements of these specifications shall be considered a component of this division of the specifications.
B. This section of the specifications includes general provisions applicable to all work of *Division 26 and Division 28.*
C. The Contractor shall examine all other divisions of the specifications and all drawings for the project and shall familiarize himself with all features of the project that may affect his work.

1.02 RELATED WORK

A. Refer to the other sections of the specifications for requirements other than these listed in these electrical specifications including but not limited to:
   1. Instructions to Bidders.
   2. Construction Agreement.
   3. Special Conditions.
   4. Project Coordination Meetings.
   5. Submittals.
   6. Quality Control Services.
   7. Construction Facilities and Temporary Controls.
   8. Project Closeout.
   9. Project Record Documents.
   10. Operating and Maintenance Data.
   11. Painting.
   12. Firestopping.
   13. Automatic Sprinkler & Fire Protection.
   14. Plumbing.
   15. Heating, Ventilating and Air Conditioning.
   16. Cast-In-Place Concrete.

1.03 SCOPE

A. Includes the furnishing of all labor, supervision, materials, equipment, tools, etc., required for the complete installation of electrical systems for the referenced facility, as outlined in these specifications and/or indicated on the accompanying drawings.
B. The following specifications sections, as applicable for any project, are a part of the construction documents:
   1. *Division 26 05 19 - Low Voltage Electrical Power Conductors and Cables.*
   2. *Division 26 05 23 - Grounding and Bonding for Electrical Systems.*
   3. *Division 26 05 25 - Hangers and Supports for Electrical Systems.*
   4. *Division 26 05 00 - Conduit for Electrical Systems.*
   5. *Division 26 05 10 - Boxes for Electrical systems.*
   6. *Division 26 05 45 - Vibration and Seismic Controls for Electrical Systems and Equipment.*
   7. *Division 26 05 50 - Identification for Electrical Systems.*
   8. *Division 26 05 55 - Power System Analysis.*
   9. *Division 26 09 00 - Lighting Control Devices.*
   10. *Division 26 09 10 - Low-Voltage Transformers.*
   11. *Division 26 09 20 - Switchboards.*
   12. *Division 26 05 40 - Panelboards.*

13. *Division 26 05 30 - Wiring Devices.*
14. *Division 26 10 10 - Engine Generators.*
15. *Division 26 10 20 - Transfer Switches.*
16. *Division 26 20 20 - Lightning Protection for Structures.*
17. *Division 26 40 00 - Surge Protective Devices.*
18. *Division 26 50 10 - LED Interior Lighting.*
19. *Division 26 50 20 - Exterior Lighting.*
20. *Division 28 30 00 - Fire Detection and Alarm.*

1.04 WORK BY OTHERS

A. The following work related to work under this division of the specifications will be provided by Others:
   1. Heating, ventilating, air conditioning and plumbing equipment, including motors, motor starters and control equipment will be furnished and installed under Division 21 (Fire Protection, Division 22 (Plumbing), Division 23 Mechanical) of these specifications.
   2. Painting, except repair of factory applied finishes on electrical equipment.
   3. All formed concrete pads for electrical equipment.
   4. Telephones and associated equipment, television cable equipment, and radio communications equipment.

1.05 CODES AND PERMITS

A. All work under *Division 26* shall be installed in accordance with the requirements of the National Electrical Code as approved by authority having jurisdiction (AHJ), and the latest edition of all local or state codes, laws, and ordinances, and the requirements of the local electric utility.
B. This Contractor shall apply for, obtain, and pay for all permits required. At the conclusion of the installation, he shall secure a Certificate of Inspection, properly signed by the controlling building department, which shall state that all rules have been complied with and that the work is satisfactory.
C. This contractor shall comply with Personal Protection Requirements of NFPA 70E when working in the vicinity of existing and new electrical equipment that is energized.
D. Should any part of the plans or specifications be found to be in conflict with applicable codes or ordinances, the Contractor shall notify the Architect/Engineer before submitting his bid.

1.06 SEISMIC QUALIFICATIONS AND RESTRAINTS

A. The individual specifications listed have seismic qualifications requirements. The manufacturer is required to perform the necessary design and testing and provide proof documentation for seismic qualification of equipment and devices.
   1. *Division 26 09 10 - Low-Voltage Transformers.*
   2. *Division 26 09 20 - Switchboards.*
   3. *Division 26 05 40 - Panelboards.*
   4. *Division 26 10 10 - Engine Generators.*
   5. *Division 26 10 20 - Transfer Switches.*
   6. *Division 28 30 00 - Fire Detection and Alarm.*
B. See *Division 26 05 45* - Vibration and Seismic Controls for Electrical Systems and Equipment.

1.07 TRADE NAMES AND EQUALS

A. Manufacturer's trade names or catalog numbers used in these specifications and indicated on the drawings denote type, size, quality, and design of equipment required.
B. Where equipment is specified as "or equal," or "approved equal," it shall mean equal in the opinion of the Architect/Engineer. The Contractor is free to offer substitutions for consideration as equal after the contract is signed; however, he shall be prepared to furnish specified materials where substitutions are not approved.
   Electrical equipment shall be furnished as specified; however, alternates to the specified equipment may be submitted with a listing on a one for one basis of the specified item and equivalent item complete with required features and specified options. If there are items not acceptable, the original specified items shall be provided.

1.08 MATERIAL AND EQUIPMENT

A. All materials and equipment shall be new and of the quality specified.
B. Material or equipment that has been stored outdoors unprotected for long periods of time or otherwise damaged is not acceptable as new material.

C. Conductors to be considered new shall be manufactured within one calendar year prior to Notice to Proceed for this contract or after the Notice to Proceed date.
D. Apparatus and materials used in this work which are subject to approval of Underwriters Laboratories (UL) shall bear the UL label, or be Underwriters listed.

1.09 SUBMITTALS AND SHOP DRAWINGS

A. Electronic PDF submittals shall be provided by the contractor through normal submittal channels, the electronic review comments will be attached to the returned electronic documents. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.
B. The Engineer's review of submittals and shop drawings is only for the limited purpose of checking the same for conformity with design concept of the work as established in the contract documents and is not intended to be for the purpose of determining the accuracy of other matters that may be contained in such submittals.
C. The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.
D. Reference individual *Divisions 26 and 28* specification sections for additional submittal and shop drawing requirements.
E. Submit shop drawings on any fabricated equipment.
F. Submit manufacturer's descriptive literature on any proposed substitute items.
G. All items shall be submitted at one time in an indexed, bound brochure, except that fabricated items requiring specially prepared shop drawings may be submitted separately. A list of items requiring a separate submission shall be provided with submittal documents.

1.10 DELIVERY, STORAGE, AND HANDLING OF MATERIAL AND EQUIPMENT

A. The Contractor shall be responsible for the purchase, delivery, and storage of all materials and equipment indicated to be supplied under this section of the specifications, and it shall be his responsibility to schedule the delivery of materials and equipment at such stages of the work as will permit uninterrupted construction of all phases of the work.
B. The Contractor shall make the Architect/Engineer aware of any materials and equipment requiring long lead times that may conflict with the construction schedule. The Contractor shall offer substitutions for consideration in a timely manner for approval by the Engineer to maintain the construction schedule.
C. Where Owner furnished equipment is to be turned over to this Contractor for installation, it shall be the responsibility of this Contractor to receive such equipment and store in a safe, dry location.
D. The Contractor shall do all required rigging, hoisting, transporting, etc., of all equipment furnished under this contract, and shall further furnish any additional structural members, as may be required, for the proper support of any and all equipment furnished hereunder.

1.11 ACCURACY OF DATA

The drawings are generally diagrammatic, and except where dimensions are shown, are not intended to show the exact locations of outlets, conduits, switches, fixtures, etc. All work shall be installed as nearly as possible in the locations indicated, with only such minor adjustments as will be required to avoid interferences with structure or the work of other trades.

A. Should any structural or mechanical interferences prevent the installation of power and lighting panelboards, running of conduit, setting of junction boxes and cabinets, arrangement of lighting fixtures and method of suspension, etc., in the locations indicated on the drawings, the necessary deviations therefrom, as determined by the Engineer, must be made without additional cost to the Owner, where relocation is not over five (5) feet from the location shown on the drawings.
B. The drawings are further not intended to show all junctions or pull boxes, fittings and connections, and details of work to be done. The Contractor shall supply all necessary boxes, fittings, and connections for complete installation in a satisfactory manner.
C. Any offsets in conduit required or necessary to avoid interferences with structure, or the work of other trades, etc., shall be made at no additional cost to the Owner.
D. Refer to Architectural and Structural drawings for all dimensions of building spaces.

E. The Contractor shall prepare shop drawings, as necessary, for his use in coordinating the work to avoid interference.
F. The drawings and specifications are complementary to each other, and what is called for by one shall be as binding as if called for by both.
G. Before conduit runs are located in the building, the Contractor shall request and obtain from the Owner the latest equipment installation drawings and coordinate all conduit and other electrical work to avoid interferences with existing or new equipment. Any offsets or relocation of electrical conduit or equipment required to avoid interference with the existing or new equipment shall be done by the Contractor at no additional cost to the Owner.
H. Electrical requirements for equipment shown on the drawings has been obtained from other designers or the Owner and used as design data. Where the actual electrical requirements are different than those shown on the drawings or specified herein, the Contractor shall make the necessary adjustments without additional charges to the Owner.

1.12 COORDINATION

A. The Electrical Contractor shall coordinate his work with that of other subcontractors on the job and also with that of the Owner in order that there be no delay in the proper installation and completion of the several parts of the work.
B. The Contractor shall use every precaution to protect the work of others, and he will be held responsible for all damage done by his workers to the work of other trades. He shall also protect his work from danger of breakage, dirt, foreign materials, etc., and shall replace all work so damaged.
C. In areas where limited space exists for all trades to complete their work the Contractor shall hold a coordination meeting with all trades and develop the necessary coordination drawings to ensure each trade has sufficient space to install their work. Failing to coordinate amongst all trades shall result in relocation of materials and equipment at no additional cost to the Owner.

1.13 MANUFACTURERS' RECOMMENDATIONS

A. Unless specifically indicated otherwise, all equipment and materials shall be installed in accordance with the best recommendation of the manufacturer. A copy of the manufacturer's installation recommendations shall be kept in the Job Superintendent's office and shall be available to the Owner's representative at all times.

1.14 CUTTING AND PATCHING

A. The Contractor shall be responsible for all cutting and patching required for the installation of his work, and he shall employ workers skilled in the trades required for all cutting and patching work.
B. The Contractor shall be responsible for the proper location of all chases, recesses, and openings required for his work, and shall advise the Engineer of the sizes and locations, and furnish the necessary drawings of those required for his work in sufficient time to allow for provision of same.
C. The Contractor shall provide all sleeves, etc., required for the introduction and placement of his work, and shall be responsible for the correct location of same.
D. Beams or columns shall not be pierced without permission of the Engineer, and then only as directed. If any conduit is required through walls or floors where no sleeve has been provided, the hole shall be core drilled, as directed by the Engineer, to avoid all unnecessary damage and structural weakening.
E. Openings around electrical penetrations through walls, partitions, floors, etc., shall be fire stopped using UL approved fire stop caulking material or other approved methods, as required by code.

1.15 PROTECTION OF FLOORS

A. The Contractor's attention is directed to the need to protect finished floors, and he will be held responsible for damage he may do to finished floors.
B. The concrete floor will be poured before work of this Contractor is completed, and much of this Contractor's work will be done on finished floors in these areas.
C. Where heavy equipment is to be moved across finished floors, the Contractor shall make provisions to protect the floor by means acceptable to the Engineer.
D. Where pipe cuttings and threading operations are carried on by the Contractor, he shall provide a suitable covering material over the floor which will assure that oil and pipe cuttings do not come in contact with the finished floor. Temporary floor covering shall be plywood or other materials as

may be approved by the Engineer.

E. The Contractor shall remove all temporary floor covering, as he completes his work in each area. Any damage resulting from activities of this Contractor shall be repaired at his own expense.

1.16 PAINTING

A. Painting of materials and equipment furnished under the electrical portion of the contract, if required, will be done under a separate section of these specifications. The Electrical Contractor shall, however, refinish and restore to the original condition and appearance, all electrical equipment which has sustained damage to manufacturer's finish paint.

B. All electrical equipment shall be provided with factory applied prime and finish paint, unless otherwise specified.

1.17 SPECIAL REQUIREMENTS FOR SERVICE INTERRUPTION

A. It is essential that work under any contract not interfere with the Owner's normal operations, and this Contractor will be held responsible for damage he may cause as a result of his operating practices.

B. Normal services shall not be interrupted at any time without prior approval from the Owner's Project Manager.

C. No extra allowance will be made for prime-time work required after regular working hours. This Contractor shall include in his bid an adequate allowance to cover work requiring service shut down on weekends.

D. All requests for power interruption, of any type, shall be made and documented at least two (2) weeks prior to the actual date of the interruption. This is necessary in order to permit the Project Manager to properly coordinate the power interruption with operating personnel.

1.18 RECORD DRAWINGS

A. The Contractor shall maintain a master set of As-Built Record Drawings that show changes and any other deviations from the drawings. The markups must be made as the changes are done. The record drawings shall be submitted to the Architect/Engineer immediately after receiving substantial completion notification.

1.19 MAINTENANCE MANUALS

A. Contractor shall provide three (3) copies of operational and maintenance manuals for all equipment installed under this division of the specifications. The manuals shall include a list of spare parts and proper operational and maintenance procedures.

B. The manuals shall be organized and fully indexed. Manuals shall consist of three-ring, hard back binders with appropriate dividers for each part.

C. Manual contents shall include, but shall not be limited to the following:
   1. Name and address of Contractor, equipment manufacturer and supplier
   2. Set of approved shop drawings or approved submittal data
   3. Wiring diagrams and installation drawings
   4. Spare parts and replacement parts lists as recommended by the manufacturer
   5. Installation and operational manuals
   6. Maintenance and service manuals
   7. Proper operational procedures and maintenance procedures
   8. Copy of warranties and guarantees

D. Operating and maintenance manuals shall be submitted to the Architect/Engineer for approval, and shall become the property of the Owner before final payment will be made.

E. It shall be the responsibility of the Contractor to maintain, warrant, clean, etc., any equipment supplied by this Contractor until all installation and operating and maintenance manuals are turned over to the Owner.

1.20 TEMPORARY POWER AND LIGHTING ELECTRICAL SERVICE

A. A temporary electrical service for construction power and lighting shall be obtained by the Contractor in the name of the Contractor, who will pay all power and energy charges. Any cost for the temporary service connection shall be paid by the Contractor and not the owner. Upon project completion, this service shall be removed and equipment removed from the site.

B. All temporary wiring for construction shall conform to Article 305 of the National Electrical Code and all applicable rules and regulations of OSHA.

C. Temporary lighting shall be furnished for the duration of construction activities for all trades. Where construction activities occur in public areas the contractor shall measure the

preconstruction light levels with a meter and maintain those light levels with temporary lighting.

D. Provide power distribution system sufficient to accommodate construction operations requiring power, use of power tools, electrical heating, lighting, and start-up/testing of permanent electric-powered equipment prior to its permanent connection to electrical system. Provide proper overload protection. Ground fault circuit interrupters (GFCI) are to be used on all 120 volt, single-phase, 15 and 20 amp receptacle outlets where portable tools and equipment are used. Ground fault circuit interrupters shall be tested weekly by the Contractor.

1.21 CONSTRUCTION REVIEW

A. Review, observation, assistance, and actions by the Engineer or Owner's representative shall not be construed as undertaking supervisory control of the work or of methods and means employed by the Contractor. The review and observation activities shall not relieve the Contractor from the responsibilities of these Contract Documents.

B. The fact that the Engineer or Owner's representative do not make early discovery of faulty or omitted work shall not bar the Engineer or Owner's representative from subsequently rejecting this work and insisting that the Contractor make the necessary corrections.

C. Regardless of when discovery and rejection are made, and regardless of when the Contractor is ordered to correct such work, the Contractor shall have no claim against the Engineer or Owner's representative for an increase in the Contract price, or for any payment on account of increased cost, damage, or loss.

1.22 TESTS

A. The entire building wiring system shall be thoroughly tested and defects corrected. All electrical wiring shall be tested for continuity, shorts, improper grounds and insulation resistance. Motors shall be checked for proper rotation and branch circuit and overload protection. Panelboards and switchboards shall be checked for balanced loading. Panelboards and switchboards shall be checked for correct phase rotation. Discrepancies shall be corrected. This Contractor shall furnish test equipment and material, and shall be responsible for replacement or repair of damage due to test failures.

B. All wiring, both branch circuits and feeders, shall be tested with a megger for proper insulation resistance, as determined by the Architect/Engineer. Tests shall be made both phase-to-phase and phase-to ground.

C. After installation is complete, voltage measurements shall be made. The phase-to-phase and phase-to-neutral voltage of all distribution centers and all panelboards shall be recorded and turned over to the Engineer. Voltage shall be measured under load conditions where possible.

D. After all tests have been completed and approved by the Architect/Engineer, this Contractor shall clean all the fixtures and replace any lamps used for temporary lighting. All equipment and conduit shall be cleaned and left in working order. All debris created by the execution of the electrical work shall be removed by this Contractor. Contractor shall take all necessary precautions to keep panels, especially circuit breaker handles, clean during construction.

1.23 GUARANTEE

A. The Contractor shall guarantee to the Owner all work performed under this contract to be free from defects in workmanship and material for a period of one (1) year from date of final acceptance. Defects arising during this period will be promptly remedied by the Contractor at his own expense upon notice by the Owner. All lamps for lighting fixtures shall be excluded from this guarantee, but one (1) complete and operative set of 10% added lamps for lighting fixtures with a minimum of two of each type and wattage shall be in place at the time of final acceptance.

DIVISION 26 05 00 – CONDUITS

PART 1 GENERAL

Conduit types shall be rigid steel, IMC, schedule 40 (or heavier) PVC or EMT.

Fittings shall be steel, Cast, pot metal, or crimp type fittings shall not be permitted, zinc die-cast fittings are not allowed. EMT connectors shall be insulated throat. Plastic bushings may be used in lieu of insulated throat.

EMT couplings and connectors may be Compression or Set Screw on the interior of the building, for exterior use, connectors and couplings to be Rain Tight steel compression fittings.

All sealtite connectors must be either stamped steel or cast iron and UL listed. However, all sealtite connectors used outdoors MUST be Appleton type STB, no exceptions. Sealtite used indoors, 1 inch and larger must be Appleton type STB.

MC cable may be utilized per UL and NEC standards with the following limitations: MC cable may only be used as lighting switch legs above a dropped ceiling, but the final connection to fixtures must be with a standard 18/3 fixture whip. MC may be used to fish a finished sheetrock wall to add a switch or receptacle and must terminate to junction box and conduit within 3 feet of exiting the top of the sheetrock wall.

Conduit Uses:

1. Rigid steel conduit or IMC may be used for underground branch circuit wiring without concrete encasement when installed greater than 24 inches below finished grade. All rigid steel and IMC feeder conduits shall be encased with 3 in. of concrete on all sides and have red caution tape in trench 1 foot above concrete. Where subject to physical damage, branch circuits exposed less than 8 ft. above finish floor and all feeder conduits run above grade shall be in rigid steel conduit or IMC.

2. PVC Conduit may be used without concrete encasement for branch circuits directly under concrete slabs, when turning up out of the slab, the last 10-foot section shall be Rigid Steel conduit to above grade, then transitioning to EMT is permissible where damage is not likely. PVC may be used without concrete encasement for site lighting and marque signage power. PVC for main feeders and feeders to out buildings must be encased with a minimum of 3 inches of concrete on all sides and have red caution tape in trench 1 foot above concrete. PVC is not acceptable for any wiring above grade.

3. EMT may be used inside walls, in ceilings, and exposed where not subject to physical damage. EMT is not permitted to be installed below grade.

4. Minimum home run size shall be ¾ inch conduit, with no more than 3 ungrounded current carrying conductors per home run. For receptacle and lighting branch circuits, when they reach the area served, may be reduced to ½ inch conduit for piping to individual receptacles and lights.

   Plastic bushings or insulated throat connectors shall be used in all conduit terminations.
   Conduit shall be used in walls, from the outlet to the ceiling, for public address, intercom and MATV wiring.

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Intermediate metal conduit (IMC).
C. PVC-coated galvanized steel rigid metal conduit (RMC).
D. Flexible metal conduit (FMC).
E. Liquidtight flexible metal conduit (LFMC).
F. Electrical metallic tubing (EMT).
G. Rigid polyvinyl chloride (PVC) conduit.
H. Conduit fittings.
I. Accessories.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Concrete encasement of conduits.
B. *Division 07 84 00* - Firestopping.
C. *Division 26 05* 23 - Grounding and Bonding for Electrical Systems.
   1. Includes additional requirements for fittings for grounding and bonding.
D. *Division 26 05 25* - Hangers and Supports for Electrical Systems.
E. *Division 26 05 45* - Vibration and Seismic Controls for Electrical Systems and Equipment.
F. *Division 26 05 50* - Identification for Electrical Systems: Identification of products and requirements.
G. *Division 26 09 10* - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.

1.03 REFERENCE STANDARDS

H. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.

I. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
J. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.
K. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
L. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
M. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
N. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
O. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.
P. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
Q. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
R. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
S. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
T. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
U. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
V. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
W. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
X. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
Y. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
Z. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittals procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
C. Project Record Documents: Record actual routing for conduits installed underground and conduits embedded within concrete slabs.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Electrical non-metallic tubing is not permitted on this project. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
   1. Under Slab on Grade: Use rigid PVC conduit.
   2. Exterior, Direct-Buried: Use rigid PVC conduit.
   3. Exterior, Embedded Within Concrete: Use rigid PVC conduit.
   4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit or intermediate metal conduit (IMC) where emerging from underground.
   5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows or intermediate metal conduit (IMC) elbows for bends.

D. Embedded Within Concrete:
   1. Within Slab on Grade: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
   2. Within Slab Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
   3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
   4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.

E. Concealed Within Masonry Walls: Use rigid PVC conduit.

F. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).

G. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).

H. Interior, Damp or Wet Locations: Use PVC-coated galvanized steel rigid metal conduit.

I. Exposed, Interior, Not Subject to Physical Damage and in excess of 10'-0" A.F.F.: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

K. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

M. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

N. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
   1. Maximum Length: 6 feet (1.8 m).

O. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
   3. Maximum Length: 6 feet (1.8 m) unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.
      b. Motors.

2.02 CONDUIT REQUIREMENTS

A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.

B. Electrical Service Conduits: Also comply with *Division 26 05 00*.

C. Communications Systems Conduits: Also comply with *Division 27 05 00*.
D. Fittings for Grounding and Bonding: Also comply with *Division 27 05 20*.
E. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
F. Provide products listed, classified, and labeled as suitable for the purpose intended.
G. Minimum Conduit Size, Unless Otherwise Indicated:
    1. Branch Circuits: 3/4-inch (21 mm) trade size.
    2. Branch Circuit Homeruns: 3/4-inch (21 mm) trade size.
    3. Control Circuits: 1/2-inch (16 mm) trade size.
    4. Flexible Connections to Luminaires: 3/8-inch (12 mm) trade size.
    5. Underground, Interior: 3/4-inch (21 mm) trade size.
    6. Underground, Exterior: 1 inch (27 mm) trade size.
H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
    1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
    2. Nucor Tubular Products: www.nucortubular.com/#sle.
    3. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
    4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
C. Fittings:
    1. Manufacturers:
        a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
        b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
        c. Thomas & Betts Corporation: www.tnb.com/#sle.
        d. Substitutions: See *Division 01 60 00* - Product Requirements.
    2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
    3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
    4. Material: Use steel or malleable iron.
        a. Do not use die cast zinc fittings.
    5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:
    1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
    2. Nucor Tubular Products: www.nucortubular.com/#sle.
    3. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
    4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
C. Fittings:
    1. Manufacturers:
        a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
        b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
        c. Thomas & Betts Corporation: www.tnb.com/#sle.
        d. Substitutions: See *Division 01 60 00* - Product Requirements.
    2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
    3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
    4. Material: Use steel.
        a. Do not use die cast zinc fittings.
    5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and

compression (gland) type fittings are not permitted.

2.05 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Thomas & Betts Corporation: www.tnb.com.
   2. Robroy Industries: www.robroy.com.
   3. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil (1.02 mm).
D. Interior Coating: Urethane, minimum thickness of 2 mil (0.05 mm).
E. PVC-Coated Fittings:
   1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
   2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
   3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
   4. Material: Use steel or malleable iron.
   5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil (1.02 mm).
   6. Interior Coating: Urethane, minimum thickness of 2 mil (0.05 mm).
F. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil (0.38 mm).

2.06 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com.
   2. Electri-Flex Company: www.electriflex.com.
   3. International Metal Hose: www.metalhose.com.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel.
      a. Do not use die cast zinc fittings.

2.07 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com.
   2. Electri-Flex Company: www.electriflex.com.
   3. International Metal Hose: www.metalhose.com.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel.

a. Do not use die cast zinc fittings.

2.08 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com.
   2. Nucor Tubular Products: www.nucortubular/#sle.
   3. Wheatland Tube Company: www.wheatland.com.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel.
      a. Do not use die cast zinc fittings.
   4. Connectors and Couplings: Use compression (gland) type.
      a. Do not use indenter type connectors and couplings.
      b. Do not use set-screw type connectors and couplings.
   5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
   6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are not acceptable.

2.09 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
   1. Cantex Inc: www.cantexinc.com/#sle.
   2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
   3. JM Eagle: www.jmeagle.com/#sle.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.10 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil (0.51 mm).

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force (890 N).

E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

F. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
D. Install intermediate metal conduit (IMC) in accordance with NECA 101.
E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
G. Conduit Routing:
    1. Unless dimensioned, conduit routing indicated is diagrammatic.
    2. When conduit destination is indicated without specific routing, determine exact routing required.
    3. Conceal all conduits unless specifically indicated to be exposed.
    4. Conduits in the following areas may be exposed, unless otherwise indicated:
        a. Electrical rooms.
        b. Mechanical equipment rooms.
        c. Within joists in areas with no ceiling.
    5. Unless otherwise approved, do not route conduits exposed:
        a. Across floors.
        b. Across roofs.
        c. Across top of parapet walls.
        d. Across building exterior surfaces.
    6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
    7. Arrange conduit to maintain adequate headroom, clearances, and access.
    8. Arrange conduit to provide no more than the equivalent of three 90 degree bends between pull points.
    9. Arrange conduit to provide no more than 150 feet (46 m) between pull points.
    10. Route conduits above water and drain piping where possible.
    11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
    12. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
    13. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
        a. Heaters.
        b. Hot water piping.
        c. Flues.
    14. Maintain 12 inches earth or 3 inches concrete separation between electrical conduits and other services or utilities.
    15. Group parallel conduits in the same area together on a common rack.
H. Conduit Support:
    1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
    2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
    3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
    4. Use conduit strap to support single surface-mounted conduit.
        a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
    5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
    6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
    7. Use trapeze hangers assembled from threaded rods and metal channel (strut) with

accessory conduit clamps to support multiple parallel suspended conduits.

8. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
9. Use of spring steel conduit clips for support of conduits is not permitted.
    a. Support of electrical metallic tubing (EMT) up to 1 inch (27 mm) trade size concealed above accessible ceilings and within hollow stud walls.
10. Use of wire for support of conduits is not permitted.
11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

I. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

J. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
9. Provide metal escutcheon plates for conduit penetrations exposed to public view.
10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in *Division 07 84 00*.

K. Underground Installation:
1. Provide trenching and backfilling in accordance with *Division 31 20 00*.
2. Minimum Cover, Unless Otherwise Indicated or Required:
    a. Underground, Exterior: 24 inches (610 mm).
    b. Under Slab on Grade: 12 inches (300 mm) to bottom of slab.
3. Provide underground warning tape in accordance with *Division 26 05 50* along entire conduit length for service entrance where not concrete-encased.

L. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
1. Include proposed conduit arrangement with submittals.
2. Maximum Conduit Size: 1 inch (27 mm) unless otherwise approved.
3. Minimum Conduit Spacing: one inch.

4. Install conduits within middle one third of slab thickness.
5. Secure conduits to prevent floating or movement during pouring of concrete.

M. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with *Division 03 30 00* with minimum concrete cover of 3 inches (76 mm) on all sides unless otherwise indicated.

N. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.

O. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings or approved flexible connections to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where conduits are subject to earth movement by settlement or frost.

P. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
3. Where conduits penetrate coolers or freezers.

Q. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 24 inches at each end.

R. Provide grounding and bonding in accordance with *Division 26 05 23*.

S. Identify conduits in accordance with *Division 26 05 00*.

T. Installation of Electrical Raceways
1. All wiring shall be installed in a continuous raceway system.
2. Conduit shall be run concealed or exposed, as specifically indicated on the plans. In general, conduit is indicated to be run concealed in finished areas; all other conduit is run exposed.
3. Install conduit only after proposed runs have been checked on plans and at site for interference with other trades. Wherever possible, locate conduit over piping of other trades. All horizontal conduit runs above furred ceilings shall be run as high as possible in order to provide free space above ceiling for installation of air distribution duct and piping.
4. Roughing-in dimensions of electrically operated equipment will be by trades supplying same. Set conduit and boxes for connecting to equipment only after receiving approved dimensions and after checking locations with other contractors.
5. Plug the ends of each raceway with an approved cap, or capped bushing to prevent the entrances of foreign material during the construction period. Conduit left empty for future wiring shall be capped.
6. Arrangements of conduit wiring and equipment that differ materially from the obvious intent of the plans will not be permitted, except where necessary to avoid interferences and only where specifically approved by the Architect.
7. From each flush mounted panelboard, extend into an accessible location a 3/4" empty conduit for every three (3) spare branch breakers and spaces.
8. Galvanized rigid steel or IMC conduit, as required, shall be used to support all pendent mounted lighting fixtures.
9. Plenum-type cable shall be supported by metal j-hooks. The Contractor must submit for approval all j-hooks. J-hooks shall be mounted within 18" each direction from where the cable enters or exits a conduit, within 12" each direction of all 90° inside and outside corners and each 4 linear feet along the run of the cable. All cables shall be secured to the two immediate j-hooks located at outside corners with a 1/4", minimum size, plastic or nylon cable-tie, leaving adequate slack in the cables to prevent the abrasion of the cables' jacket. The cables shall be pulled tight and secured to a j-hook each 20 linear feet to prevent excessive sagging of the cables.

3.03 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
D. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

DIVISION 26 05 10 – BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.
B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).
C. Boxes for hazardous (classified) locations.
D. Floor boxes.
E. Underground boxes/enclosures.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete.
B. *Division 07 84 00* - Firestopping.
C. *Division 08 31 00* - Access Doors and Panels: Panels for maintaining access to concealed boxes.
D. *Division 26 05 23 - Grounding and Bonding for Electrical Systems.*
E. *Division 26 05 25 - Hangers and Supports for Electrical Systems.*
F. *Division 26 05 00 - Conduit for Electrical Systems:*
    1. Conduit bodies and other fittings.
    2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
G. *Division 26 05 50 - Identification for Electrical Systems: Identification of products and requirements.*
H. *Division 26 05 30 - Wiring Devices:*
    1. Wall plates.
    2. Floor box service fittings.
    3. Poke-through assemblies.
    4. Access floor boxes.
    5. Additional requirements for locating boxes for wiring devices.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013 (Reaffirmed 2020).
F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
K. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
L. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
M. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.
N. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.
C. Samples:
1. Floor Boxes: Provide one sample(s) of each floor box proposed for substitution upon request.
D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
E. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Keys for Lockable Enclosures: Two of each different key.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
   4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
   5. Use nonmetallic boxes where exposed rigid PVC conduit is used.
   6. Use suitable concrete type boxes where flush-mounted in concrete.
   7. Use suitable masonry type boxes where flush-mounted in masonry walls.
   8. Use raised covers suitable for the type of wall construction and device configuration where required.
   9. Use shallow boxes where required by the type of wall construction.
   10. Do not use "through-wall" boxes designed for access from both sides of wall.
   11. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   12. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   13. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
   14. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
   15. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
   16. Minimum Box Size, Unless Otherwise Indicated:
      a. Wiring Devices: single gang, 2.5" depth.
      b. Communications Systems Outlets: Comply with *Division 27 10 00*.
      c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
      d. Exposed wiring, 4" square, 2-1/4" minimum depth.
   17. Wall Plates: Comply with *Division 26 05 30*.
   18. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com.
      c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com.
      d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      e. Thomas & Betts Corporation: www.tnb.com/#sle.
      f. Substitutions: See *Division 01 60 00* - Product Requirements.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
   1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.

2. NEMA 250 Environment Type, Unless Otherwise Indicated:
   a. Indoor Clean, Dry Locations: Type 1, painted steel.
   b. Outdoor Locations: Type 3R, painted steel.
3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
   a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
   b. Boxes 6 square feet (0.56 sq m) and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
   a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
   b. Back Panels: Painted steel, removable.
   c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
6. Manufacturers:
   a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
   b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
   c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
   d. Substitutions: See *Division 01 60 00* - Product Requirements.

D. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
1. Manufacturers:
   a. Appleton, a brand of Emerson Electric Co; www.emerson.com/#sle.
   b. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
   c. Hubbell Incorporated; Killark Products: www.hubbell-killark.com/#sle.
   d. Substitutions: See *Division 01 60 00* - Product Requirements.

E. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 2726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Use cast iron floor boxes within slab on grade.
3. Use sheet-steel or cast iron floor boxes within slab above grade.
4. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
5. Manufacturer: Same as manufacturer of floor box service fittings.

F. Underground Boxes/Enclosures:
1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As indicated on drawings.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches (300 mm).
4. Provide logo on cover to indicate type of service.
5. Applications:
   a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
   b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.
   c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
   a. Manufacturers:
      1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com/#sle.
      2) Oldcastle Precast, Inc: www.oldcastleprecast.com/#sle.
      3) Substitutions: See *Division 01 60 00* - Product Requirements.
   b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that mounting surfaces are ready to receive boxes.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
D. Provide separate boxes for emergency power and normal power systems.
E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
H. Box Locations:
    1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
    2. Unless dimensioned, box locations indicated are approximate.
    3. Locate boxes as required for devices installed under other sections or by others.
        a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
        b. Communications Systems Outlets: Comply with Section 27 1000.
    4. Locate boxes so that wall plates do not span different building finishes.
    5. Locate boxes so that wall plates do not cross masonry joints.
    6. In all cases, where two or more devices are installed in gang boxes, gang plates with suitable openings shall be provided.
    7. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
    8. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.
    9. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) horizontal separation.
    10. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
        a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
        b. Do not install flush-mounted boxes with area larger than 16 square inches (0.0103 sq m) or such that the total aggregate area of openings exceeds 100 square inches (0.0645 sq m) for any 100 square feet (9.29 sq m) of wall area.
    11. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
    12. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
        a. Concealed above accessible suspended ceilings.
        b. Within joists in areas with no ceiling.
        c. Electrical rooms.
        d. Mechanical equipment rooms.
    13. Except where indicated otherwise on the drawings, outlet boxes shall be so located as to allow the associated device or fixture to be mounted in compliance with the accessibility code applicable to this project location and at locations specified below:
        a. Ceiling lighting fixtures - Symmetrically in/or on ceiling, or as indicated on the plans.
        b. Receptacles - 1'-6" above finished floor to the center of the box in finished areas; the

lesser of 8" above counter tops or 3'-10"; except where specifically indicated otherwise on the plans.

c. Wall switches and fire alarm manual stations - 4'-0" above finished floor or as specifically indicated on the plans.

d. Thermostats - 4'-0" above finished floor or as specifically indicated on the plans.

e. Outlets for other devices - As indicated on the plans.

I. Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
5. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

J. Box Mounting:

1. Before installation, check proposed location of each outlet box with the architectural, structural, and mechanical drawings and locate each outlet box so that they will be accessible and interference free in the finished project.
2. Set each concealed box flush with finished surfaces, and so that exposed finished surface will not be marred.
3. Install each wall switch on the strike side of the door involved unless otherwise indicated. Before placing each wall switch box, verify the applicable door swing with the architectural drawings, and locate the wall switch box accordingly.
4. Where exposed flexible cords serve equipment, locate the outlet box as near as practicable to the equipment connection point, to minimize flexible cord length.
5. All outlet boxes in or on ceilings shall be supported from the tee bar or ceiling support member with a hanger designed for this purpose that secures it to the tee bar or ceiling support. Neither the box nor the device attached to that box shall be supported by the ceiling material. The hanger shall be secured to the tee bar or ceiling support with a screw run through the vertical part of the tee bar or support and hanger at each point at which it attached.
6. All outlet boxes in or on gypsum board and stud walls shall be secured to the studs or bracing. The gypsum board material shall not support the boxes.

K. Install boxes plumb and level.

L. Flush-Mounted Boxes:

1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.

M. Floor-Mounted Cabinets: Mount on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with *Division 03 30 00*.

N. Install boxes as required to preserve insulation integrity.

O. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

P. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.

Q. Underground Boxes/Enclosures:

1. Install enclosure on gravel base, minimum 6 inches (150 mm) deep.
2. Flush-mount enclosures located in concrete or paved areas.
3. Mount enclosures located in landscaped areas with top at 1 inch (25 mm) above finished

grade.

4. Provide cast-in-place concrete collar constructed in accordance with Section 03 3000, minimum 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep), around enclosures that are not located in concrete areas.
5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

R. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
S. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in *Division 07 84 00*.
T. Close unused box openings.
U. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
V. Provide grounding and bonding in accordance with *Division 26 05 23*.
W. Identify boxes in accordance with *Division 26 05 10*.
X. Use temporary covers at all outlet box locations during construction to prevent entrance of dirt, plaster, etc. before wiring device is installed.
Y. Where multiple feeders are located in the same general area, each feeder shall be provided with separate junction or pull boxes. The practice of combining several feeders in a common pull box or junction box will not be permitted. Where parallel conductors are used on the same feeder circuit, they may be combined within a common pull box, or junction box.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

DIVISION 26 05 19 – LOW-VOLTAGE WIRES, CABLES AND CONDUCTORS

PART 1 GENERAL

All conductor materials shall be copper. Aluminum conductors **are not allowed** as main feeders. Only in special conditions and with written approval by Owner will aluminum be allowed.

All low voltage wiring, including fire alarm, data, controls, security, etc., where exposed shall be in conduit to be painted at the owner's discretion.

Provide plenum rated cabling for low voltage cabling and wiring.

Contractor Shall include the purchasing, installation, testing, and maintenance of systems that operate at 50 volts or less. These systems are essential for communications, security, and automation in MSCS districts commercial, industrial, and residential buildings. The contractor shall provide all labor, materials, equipment, and services necessary to remove existing low voltage cabling there after installation of new systems. This includes structured cabling, security systems, audio/visual setups, and building automation components where applicable in all cases to complete functioning system.

Project Planning & Coordination

- Review construction drawings and specifications.
- Coordinate with MSCS project teams, general contractors, electricians, and other trades.
- Attend project meetings and site walkthroughs.
- Responsibility for obtaining permits or scheduling inspections may be excluded unless specified.
- Includes trenching, core drilling, wall penetrations, or any structural alterations unless explicitly stated.
- Work in hazardous environments (e.g., asbestos, mold, contaminated areas) is included unless addressed separately.
- Inspect existing cabling infrastructure.
- Identify obsolete or damaged cabling.
- Document cable routes and termination points.
- Develop a detailed cabling layout.

- Ensure compliance with BICSI, TIA/EIA, IEEE, NFPA, and ISO/IEC standards.
- Coordinate with IT and facilities teams for access and scheduling
- Contractors shall replace any ceiling tiles, wall finishes, or flooring that are damaged during construction activities, restoring them to their original condition or better, at no additional cost to the owner**."**

Cable Installation

- Pulling and routing of low voltage cables (e.g., Cat6, fiber optic, coaxial, speaker wire, Etc.
- Installation of cable trays, conduits, raceways, and supports.
- Labeling and documentation of all cable runs before Removal of Existing Cabling**.** Safely disconnect and remove all outdated or non-compliant low voltage cabling.
- Dispose of removed materials in accordance with environmental regulations.
- Ensure minimal disruption to ongoing operations.
- Removing dust, debris, and construction materials daily
- Cleaning floors, windows, walls, and fixtures daily
- Ensuring the site is safe, presentable, and ready for public use/occupancy daily

Termination & Testing

- Termination of cables at patch panels, jacks, and devices.
- Testing for continuity, signal strength, and certification (e.g., Fluke testing).
- Troubleshooting and correcting any deficiencies.
- Final testing, certification, or commissioning may be excluded unless explicitly included in the scope.

System Installation

- Installation of devices such as:
- Network switches and routers
- Wireless access points
- Security cameras (CCTV)
- Access control systems
- Intercom and Paging Systems
- Audio/visual equipment
- Rack and cabinet installation and dressing.

Documentation & As-Builts

- Provide updated as-built drawings.
- Submit test results and certification reports.
- Deliver operation and maintenance manuals.
- Provide warranty for workmanship and materials.
- Offer emergency support within a specified response time (e.g., 2 hours).
- Include routine maintenance and troubleshooting services.

Compliance & Safety

- Ensure compliance with Local and State, BICSI, TIA/EIA, IEEE, NFPA, AND ISO/IEC standards.
- Use of proper PPE and safety procedures.
- Firestopping and pathway sealing as required.

1.01 SECTION INCLUDES

A. Single insulated building conductors.
B. Wiring connectors.
C. Electrical tape.
D. Heat shrink tubing.
E. Oxide inhibiting compound.
F. Wire pulling lubricant.
G. Types of wire, cable, and connectors:
    1. Copper building wire.
    2. Fixture wire.
    3. Terminal connectors.
    4. Splice connectors.
H. Applications for wire, cable, and connectors:
    1. Power distribution circuitry.
    2. Lighting and outlet circuitry.
    3. Appliance and equipment circuitry.

4. Motor-branch circuitry.
5. Grounding.

1.02 RELATED REQUIREMENTS

A. *Division 07 84 00* - Firestopping.
B. *Division 26 05* 23 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
C. *Division 26 05 50* - Identification for Electrical Systems: Identification of products and requirements.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.
G. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); 2008a (Validated 2019).
H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
J. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
L. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
M. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
N. UL 183 - Manufactured Wiring Systems; Current Edition, Including All Revisions.
O. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
P. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
Q. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the installation of direct burial cable with other trades to avoid conflicts with piping or other potential conflicts.
   3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   4. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
C. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.
D. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring

gutters, enclosures, etc. to accommodate substituted conductors. Preapproval required for aluminum substitution.

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See *Division 01 60 00* - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Comply with NEC as applicable to construction and installation of electrical conductors, wire, cable and connectors.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect/Engineer and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single insulated building conductors installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is permitted only where specifically indicated on the contract drawings.

D. Nonmetallic-sheathed cable is not permitted.

E. Underground feeder and branch-circuit cable is not permitted.

F. Service entrance cable is not permitted.

G. Armored cable is not permitted except as indicated below.

1. Where not otherwise restricted, may be used:

a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.

1) Maximum Length: 6 feet (1.8 m).

H. Metal-clad cable is not permitted.

I. Manufactured wiring systems are not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled by Underwriters Laboratories, Inc. as suitable for the purpose intended.

C. Provide new conductors and cables manufactured not more than one year prior to installation.

D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

E. Comply with NEMA WC 70.

F. Comply with FS A-A-59544 where applicable.

G. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

H. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

I. Conductors for Grounding and Bonding: Also comply with Section 26 0526.

J. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.

K. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.
L. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
M. Conductor Material:
    1. Provide copper conductors only. Aluminum or Aluminum alloy conductors are not acceptable for this project.
    2. Copper Conductors: Soft drawn annealed, 98% conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
    3. Tinned Copper Conductors: Comply with ASTM B33.
N. Minimum Conductor Size:
    1. Branch Circuits: 12 AWG. Increase branch circuit conductors in size where necessary to compensate for voltage drop, in accordance with NEC requirements. Generally, the following criteria can be used to determine sizing for various lengths of normally loaded branch circuits protected at 20 amps with evenly distributed loads:
        a. 120/208 Volts, #12 AWG, 0 - 85 ft.
        b. 120/208 Volts, #10 AWG, 85 - 140 ft.
        c. 120/208 Volts, #8 AWG, 140 - 220 ft.
        d. 120/208 Volts, #6 AWG, 220 - 320 ft.
        e. 277/480 Volts, #12 AWG, 0 - 140 ft.
        f. 277/480 Volts, #10 AWG, 140 - 220 ft.
        g. 277/480 Volts, #8 AWG, 220 - 350 ft.
        h. 277/480 Volts, #6 AWG, 350 - 500 ft.
O. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
P. Conductor Color Coding:
    1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
    2. Color Coding Method: Integrally colored insulation.
        a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
    3. Color Code:
        a. 480Y/277 V, 3 Phase, 4 Wire System:
            1) Phase A: Brown.
            2) Phase B: Orange.
            3) Phase C: Yellow.
            4) Neutral/Grounded: Gray.
        b. 208Y/120 V, 3 Phase, 4 Wire System:
            1) Phase A: Black.
            2) Phase B: Red.
            3) Phase C: Blue.
            4) Neutral/Grounded: White.
        c. Equipment Ground, All Systems: Green.
        d. Isolated Ground, All Systems: Green with yellow stripe.
        e. Travelers for 3-Way and 4-Way Switching: Pink or Purple.
        f. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction. Where no color code exists, new work shall be in accordance with color codes described in these specifications.
        g. For control circuits, comply with manufacturer's recommended color code.
        h. Because no color code has been established for the different control systems and the addressable fire alarm system conductors are red-jacketed, all conductors shall be identified by the use of adhesive numbers. These conductors shall be identified at their origin, each junction box and at their termination.

2.03 SINGLE INSULATED CONDUCTORS

A. Manufacturers:
   1. Copper Insulated Conductors:
      a. Cerro Wire LLC: www.cerrowire.com/#sle.
      b. Encore Wire Corporation: www.encorewire.com/#sle.
      c. Southwire Company: www.southwire.com/#sle.
      d. Approved Equal.
      e. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Description: Single insulated conductors.
C. Conductor Stranding:
   1. Feeders and Branch Circuits:
      a. Size 10 AWG and Smaller: Solid.
      b. Size 8 AWG and Larger: Stranded.
   2. Control Circuits: Stranded.
D. Insulation Voltage Rating: 600 V.
E. Insulation:
   1. Copper Conductors: Type THHN/THWN or THHN/THWN-2, except as indicated below.
      a. Size 4 AWG and Larger: Type THHN/THWN or THHN/THWN-2.
      b. Installed Underground in raceway: Type THHN/THWN or THHN/THWN-2.
      c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Type SA for luminaires with labeled maximum temperature greater than 90 degrees C.

2.04 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
B. Connectors for Grounding and Bonding: Comply with Section 26 0526.
C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors, mechanical connectors, or compression connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Connectors for #4 and larger conductors shall be color keyed long barrel type. Lugs shall have two (2) holes for connection to terminals or busses.
   3. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
   4. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   5. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
   6. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required for all connections.
   7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
   8. Conductors for Control Circuits: Use crimped terminals for all connections.
E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
   1. Manufacturers:

a. 3M; Performance Plus Series: www.3m.com.
b. Ideal Industries, Inc; Twister Series: https://idealind.com, www.idealindustries.com.
c. NSI Industries LLC; Easy Twist (not N-Type): www.nsiindustries.com.
d. Approved Equal.
e. Substitutions: See *Division 01 60 00* - Product Requirements.

H. Mechanical Connectors: Provide bolted type or set-screw type.
1. Manufacturers:
a. Burndy LLC: www.burndy.com.
b. Ilsco: www.ilsco.com.
c. Thomas & Betts Corporation: www.tnb.com.
d. Approved Equal.
e. Substitutions: See *Division 01 60 00* - Product Requirements.

I. Compression Connectors: Provide circumferential type, hex type, or indentor type crimp configuration.
1. Manufacturers:
a. Burndy LLC: www.burndy.com.
b. Ilsco: www.ilsco.com.
c. Thomas & Betts Corporation: www.tnb.com.
d. Approved Equal.
e. Substitutions: See *Division 01 60 00* - Product Requirements.

J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
1. Manufacturers:
a. Burndy LLC: www.burndy.com.
b. Ilsco: www.ilsco.com.
c. Thomas & Betts Corporation: www.tnb.com.
d. Approved Equal.
e. Substitutions: See *Division 01 60 00* - Product Requirements.

K. Motor Terminations: Motor terminations for 600 volts or less.
1. Manufacturers:
a. Thomas & Betts Corporation: Type MSC; www.tnb.com.
b. Raychem: Type MCK;
c. Approved Equal.
d. Substitutions: See *Division 01 60 00* - Product Requirements.

2.05 WIRING ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
a. 3M: www.3m.com.
b. Plymouth Rubber Europa: www.plymouthrubber.com.
c. Approved Equal.
d. Substitutions: See *Division 01 60 00* - Product Requirements.
2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil (0.76 mm); suitable for continuous temperature environment up to 194 degrees F (90 degrees C) and short-term 266 degrees F (130 degrees C) overload service.
5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil (3.2 mm); suitable for continuous temperature environment up to 176 degrees F (80 degrees C).

6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil (2.3 mm).

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
   1. Manufacturers:
      a. 3M: www.3m.com.
      b. Burndy LLC: www.burndy.com.
      c. Thomas & Betts Corporation: www.tnb.com.
      d. Approved Equal.
      e. Substitutions: See *Division 01 60 00* - Product Requirements.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com.
      b. Ideal Industries, Inc: www.idealindustries.com.
      c. Ilsco: www.ilsco.com.
      d. Approved Equal.
      e. Substitutions: See *Division 01 60 00* - Product Requirements.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
   1. Manufacturers:
      a. 3M: www.3m.com.
      b. American Polywater Corporation: www.polywater.com.
      c. Ideal Industries, Inc: www.idealindustries.com.
      d. Approved Equal.
      e. Substitutions: See *Division 01 60 00* - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location indicated.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
      a. Size raceways, boxes, etc. to accommodate conductors.
   8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
   9. Provide oversized neutral/grounded conductors where indicated and as specified below.
      a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
      b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent

rated neutral bus.

B. Install products in accordance with manufacturer's instructions.
C. Perform work in accordance with NECA 1 (general workmanship).
D. Installation in Raceway:
    1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
    2. Pull all conductors and cables together into raceway at same time.
    3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
    4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner. In 3 phase systems, each conduit shall have A, B, C phases and neutral (unless neutral is not applicable).
F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
    1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
    2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
G. Terminate cables using suitable fittings.
H. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
I. Where conductors are installed in enclosures for future termination by others, provide a minimum of 6 feet of slack.
J. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
K. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
L. Make wiring connections using specified wiring connectors.
M. Make splices and taps only in accessible boxes and in accordance with the NEC. Do not pull splices into raceways or make splices in conduit bodies. All conductors shall be continuous from outlet to outlet or from panel to outlet or device. No splices will be permitted in conduit runs.
    1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
    2. Do not remove conductor strands to facilitate insertion into connector.
    3. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
    4. Mechanical Connectors: Secure connections according to manufacturers' recommended torque settings.
    5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
    1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
        a. For taped connections, first apply adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
    2. Damp Locations: Use insulating covers specifically designed for the connectors or heat shrink tubing.
        a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
        b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.

3. Wet Locations: Use heat shrink tubing.

O. Insulate ends of spare conductors using vinyl insulating electrical tape.

P. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible. Start wrap at 1-inch from end of stripped insulation and extend to a 3-inch length of tape coverage. The amount of tape used will be more and is determined by conductor size.

Q. Identify conductors and cables in accordance with Section 26 0553.

R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

S. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

T. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary, for proper interface.

U. Wire shall be protected during storage and handling and shall be in first class condition when installed.

V. No grease of any kind and no compound other than a neutral lubricant as approved by the wire or cable manufacturer shall be used as a pulling compound.

W. Use pulling means, including fish tape, cable, or rope which cannot damage raceway.

X. Torque all bolted lugs and connectors to torque values recommended by the equipment manufacturer. Where torque values are not given, use applicable torque values given by UL Standards #486A and #486B. If studs are copper or steel, or if steel bolts are used, use a Belleville dished washer with a wide series, heavy flat washer. Tighten the connection until the Belleville is flat. Do not retighten later.

3.04 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.

B. Perform inspection, testing, and adjusting in accordance with *Division 01 40 00*.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Perform inspections and tests listed in NETA ATS, Section 7.3.2 and as required as follows:

1. 480 Volt power cables shall be given a meg-ohmmeter test using a 1000 Volt instrument. Tests shall be maintained until readings are steady.
2. Prior to energization, test all lighting, power, control and special circuits and associated electrical equipment for low insulation resistance, grounds and short circuits.
3. Give the Architect/Engineer sufficient notice prior to any test so that his representative can be present to observe the testing.
4. Furnish and set up all meters, instruments, equipment and labor required to make tests, as indicated.
5. Promptly replace any work found to be defective under test. After replacement, test work again. Final acceptance of work depends on successful completion of operational tests on all equipment to show that the equipment will perform the functions for which it was designed.
6. Repair and/or replace at Contractor's expense, any equipment damaged in the process of conducting the tests.
7. Test results shall show values no smaller than those recommended by the NEC, IPCEA, IEEE, ANSI and NEMA.
8. Make meg-ohmmeter tests on power cables between each conductor and ground with other conductors connected to the same ground.
9. Make meg-ohmmeter tests from circuit conductor to circuit conductor and from circuit conductor to ground for branch circuits and feeders, and from control circuit conductor to ground of all control wiring, including spares.
10. Perform continuity tests on all power and control circuits, including spare conductors. Check phase identification on power cables.
11. Check all control and interlocking wiring for proper operations. Perform operational tests with Architect/Engineer to assure that control wiring has been properly installed.
12. Record the insulation resistance readings of all feeder and motor circuits and submit test results to the Architect/Engineer.

13. Control cables shall be checked for continuity and identification and given a meg-ohmmeter test with a 500 Volt meg-ohm meter.

E. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

F. Correct deficiencies and replace damaged or defective conductors and cables.

DIVISION 26 05 20 - ELECTRICAL CONNECTIONS TO EQUIPMENT

GENERAL

The Electrical Contractor shall provide power wiring to all Kitchen, Plumbing or HVAC equipment.

The Kitchen Equipment, Plumbing or HVAC Contractors will be required to make final connections inside the equipment from slack wire left by Electrical Contractor for system check out.

All disconnect switches and starters shall be supplied to the Electrical Contractor by the Kitchen Equipment, Plumbing or HVAC Contractors for mounting and wiring. The supplying Contractors shall furnish all fuses and heaters. Show detailed drawings to avoid confusion.

All connections to equipment subject to moisture, not supplied with factory installed cord shall be connected with UL listed LFMC utilizing steel or cast-iron fittings, where not subject to moisture FMC with steel or cast-iron fittings may be used.

LFNC (Carflex) is not permitted.

Provide dedicated 120 volt, 20 AMP circuits at all Energy Management System (EMS) panel locations and in all mechanical rooms or other mechanical equipment locations requiring 120-volt control power.

Provide a dedicated 120-volt, 20-amp circuits at the Fire Alarm Control Panel location and for security monitoring equipment supplied by Owner's vendor, and supply breaker lock

DIVISION 26 05 23 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.
B. Conductors for grounding and bonding.
C. Connectors for grounding and bonding.
D. Ground bars.
E. Ground rod electrodes.
F. Ground access wells.
G. Types of grounding:
   1. System and enclosure grounding for electrical distribution systems.
   2. Separately derived electrical systems.
   3. Enclosures bonding.
   4. Equipment grounding and bonding.

1.02 RELATED REQUIREMENTS

A. *Division 26 05 19* - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
   1. Includes oxide inhibiting compound.
B. *Division 26 05 50* - Identification for Electrical Systems: Identification of products and requirements.
C. *Division 26 50 20* - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.
G. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittals procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
C. Shop Drawings:
   1. Include locations of items to be bonded and methods of connection.
D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
E. Field quality control test reports.
F. Project Record Documents: Record actual locations of grounding electrode system components and connections where not visible after construction.

1.06 QUALITY ASSURANCE

A. Comply with NEC requirements as applicable to materials and installation of electrical grounding systems, associated equipment, and wiring. Provide grounding products which are UL listed and labeled.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.
D. Installer Qualifications for Signal Reference Grids: Company with minimum five years' documented experience with high frequency grounding systems.
E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
D. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect/Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 25 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

E. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. [Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.]
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet (3.0 m) at an accessible location not more than 5 feet (1.5 m) from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
      c. Provide bonding jumper around water meter and Reduced Pressure Backflow Preventer of sufficient length to permit removal of devices without disconnecting jumper.
   3. Metal In-Ground Support Structure:
      a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
   4. Concrete-Encased Electrode, where required:
      a. Provide connection to concrete-encased electrode consisting of not less than 20 feet (6.0 m) of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
   5. Ground Ring, where indicated:
      a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches (750 mm).
      b. Where location is not indicated, locate ground ring conductor at least 24 inches (600 mm) outside building perimeter foundation.
      c. Provide ground enhancement material around conductor where indicated or required to achieve Grounding Resistance measurements described elsewhere in these specifications or required by the NEC.
      d. Provide connection from ground ring conductor to:
         1) Perimeter columns of metal building frame.
         2) Ground rod electrodes located as indicated.
   6. Three-Point Ground:
      a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
      b. Space electrodes not less than 10 feet (3.0 m) from each other and any other ground electrode.
      c. Where location is not indicated, locate electrode(s) at least 5 feet (1.5 m) outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
      d. Provide ground enhancement material around electrode where indicated.
      e. Provide ground access well as indicated.
   7. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
   8. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.

a. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
c. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.

9. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.

F. Service-Supplied System Grounding:
1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

G. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
2. Provide equipment grounding conductor routed with supply conductors.
3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

H. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
a. Transformers (except autotransformers such as buck-boost transformers).
b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
c. Generators, when neutral is switched in the transfer switch.
2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame or common grounding electrode conductor.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

I. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground buses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.

3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
    a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
    b. Metal gas piping.
    c. Metal process piping, where applicable.
8. Provide bonding for metal building frame.
9. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.

J. Isolated Ground System:
1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground buses.
3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

K. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination or building grounding electrode system to each communications room or backboard and provide ground bar for termination.
    a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required, with Green insulation.
    b. Raceway Size: 3/4 inch (21 mm) trade size unless otherwise indicated or required.
    c. Ground Bar Size: 1/4 by 4 by 12 inches (6 by 100 by 300 mm) unless otherwise indicated or required.
    d. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.

L. Pole-Mounted Luminaires: Also comply with *Division 26 50 20*.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled by Underwriter's Laboratories, Inc. (UL) or Intertek (ETL) as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of *Division 26 50 20*:
1. Use insulated copper conductors unless otherwise indicated.
    a. Exceptions:
        1) Use bare copper conductors or bare tinned copper conductors where installed underground in direct contact with earth.
        2) Use bare copper conductors or bare tinned copper conductors where directly encased in concrete (not in raceway).
2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gage of specified conductors.

C. Connectors for Grounding and Bonding:
   1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
   2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
   3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
      a. Exceptions:
         1) Use exothermic welded connections for connections to metal building frame.
   4. Manufacturers - Mechanical and Compression Connectors:
   5. Harger Lightning & Grounding: www.harger.com/#sle.
      a. Thomas & Betts Corporation: www.tnb.com/#sle.
      b. Substitutions: See *Division 01 60 00* - Product Requirements.
   6. Manufacturers - Exothermic Welded Connections:
      a. Cadweld, a brand of Erico International Corporation: www.erico.com/#sle.
      b. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
      c. Substitutions: See *Division 01 60 00* - Product Requirements.

D. Ground Bars:
   1. Description: Copper rectangular ground bars with mounting brackets and insulators.
   2. Size: As indicated.
   3. Holes for Connections: As indicated or as required for connections to be made.
   4. Manufacturers:
      a. Erico International Corporation: www.erico.com/#sle.
      b. Harger Lightning & Grounding: www.harger.com/#sle.
      c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.

E. Ground Rod Electrodes:
   1. Comply with NEMA GR 1.
   2. Material: Copper-bonded (copper-clad) steel.
   3. Size: 3/4 inch (19 mm) diameter by 10 feet (3.0 m) length, unless otherwise indicated.
   4. Manufacturers:
      a. Erico International Corporation: www.erico.com/#sle.
      b. Galvan Industries, Inc: www.galvanelectrical.com/#sle.
      c. Harger Lightning & Grounding: www.harger.com/#sle.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.

F. Chemically-Enhanced Ground Electrodes:
   1. Description: Copper tube factory-filled with electrolytic salts designed to provide a low-impedance ground in locations with high soil resistivity; straight (for vertical installations) or L-shaped (for horizontal installations) as indicated or as required.
   2. Length: 10 feet (3.0 m).
   3. Integral Pigtail: Factory-attached, sized not less than grounding electrode conductor to be attached.
   4. Backfill Material: Grounding enhancement material recommended by electrode manufacturer.
   5. Manufacturers:
      a. Erico International Corporation: www.erico.com/#sle.
      b. Harger Lightning & Grounding: www.harger.com/#sle.
      c. Substitutions: See *Division 01 60 00* - Product Requirements.

G. Ground Plate Electrodes:
   1. Material: Copper.
   2. Size: 24 by 24 by 1/4 inches (610 by 610 by 6 mm), unless otherwise indicated.
   3. Manufacturers:
      a. Erico International Corporation: www.erico.com/#sle.
      b. Harger Lightning & Grounding: www.harger.com/#sle.

c. Substitutions: See *Division 01 60 00* - Product Requirements.

H. Ground Access Wells:
1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
a. Areas Exposed to Vehicular Traffic: Rated for not less than 12,000 pounds vertical design load.
2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
a. Round Wells: Not less than 8 inches (200 mm) in diameter.
b. Rectangular Wells: Not less than 12 by 12 inches (300 by 300 mm).
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches (250 mm).
4. Cover: Factory-identified by permanent means with word "GROUND".
5. Manufacturers:
a. Erico International Corporation: www.erico.com/#sle.
b. Harger Lightning & Grounding: www.harger.com/#sle.
c. Substitutions: See *Division 01 60 00* - Product Requirements.

I. Oxide Inhibiting Compound: Comply with *Division 26 05 19*.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.
B. Verify that field measurements are as indicated.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45-degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.
1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches (150 mm) below finished grade.
2. Indoor Installations: Unless otherwise indicated, install with 4 inches (100 mm) of top of rod exposed.
D. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches (750 mm).
E. Make grounding and bonding connections using specified connectors.
1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturers' recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
F. Identify grounding and bonding system components in accordance with *Division 26 05 50*.
G. A continuous (green) equipment grounding conductor shall be provided with all feeders and branch circuits. This grounding conductor shall be insulated same as required for 600-volt phase conductors and shall be green in color, where possible. Grounding conductor shall be sized in accordance with Article 250-95 of the NEC and shall terminate by means of compression lugs at each ground bus, panelboard grounding bar, pull boxes, disconnect switches, starters, motors, and other devices.

H. Install electrical grounding systems in accordance with applicable portions of NEC, with NECA "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.
I. Coordinate with other electrical work, as necessary, to interface installation of electrical grounding system with other work.
J. Furnish and install system, enclosure, and equipment grounding for all electric wiring for the building in full compliance with the requirements of local codes and the NEC. All grounding conductors shall be copper.
K. System and enclosure grounding shall be provided at the building service entrance panelboard, switchboard or disconnecting means and shall consist of a system and equipment bond with connection to the building steel by exothermic weld, or equal. The size of the grounding conductor shall be as indicated on the drawings or, where not indicated, as per Article 250-94 of the NEC. Also, provide grounding electrode conductor, outdoor ground rod installation, as required by code.
L. Where short lengths of flexible steel conduit are used between outlet boxes in hung or furred ceiling and flush lighting fixtures, the lighting fixture shall be grounded by means of a separate #12 AWG copper (green) colored insulated grounding wire run with the circuit conductors in the flexible steel conduit and bonded to the outlet box and to the fixture enclosure by means of an approved solderless grounding lug or connector.
M. At all metal conduit terminations at switchboards, panelboards, junction boxes, transformers, or other enclosures, the end of the conduit shall be equipped with an insulated metallic grounding and bonding bushing T&B #3870, or equal. Provide code size copper bonding jumper from grounding bushing to enclosure with lug termination bolted to the enclosure. Grounding type bushings are not required for conduit terminations at cast metal enclosures having screwed hub conduit terminations.
N. Each dry type transformer installation shall have system and enclosure grounding in accordance with the requirements of Article 250-26 of NEC. A bonding jumper, sized in accordance with Article 250-79(c) of the NEC, shall be used to connect the neutral and enclosure of the secondary side of the transformer at the XO terminal.
O. Provide communications data grounding paths including conduit and conductor from the system ground at the building service entrance to telephone backboard or terminal cabinet and data equipment frame location. Size shall be as noted in Part 2 or on power or communications construction document sheets.

3.03 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Perform inspection, testing, and adjusting in accordance with Section 01 4000.
C. Inspect and test in accordance with NETA ATS except Section 4.
D. Perform inspections and tests listed in NETA ATS, Section 7.13.
E. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
F. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

DIVISION 26 05 25 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work. Types of hangers and supports:
   1. Clevis hangers.
   2. Riser clamps.
   3. C-Clamps.
   4. I-Beam clamps.
   5. One-hole conduit straps.
   6. Two-hole conduit straps.
   7. Round steel rods.

8. Lead expansion anchors.
9. Toggle bolts.
10. Wall and floor seals.
11. Steel channel strut system.

B. Supports, anchors, sleeves, and seals furnished as part of factory fabricated equipment are specified as part of equipment assembly in other Division 26 sections.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Concrete equipment pads.
B. *Division 05 50 00* - Metal Fabrications: Materials and requirements for fabricated metal supports.
C. *Division 26 05 00* - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
D. *Division 26 05 10* - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
E. *Division 26 50 10* - Interior Lighting: Additional support and attachment requirements for interior luminaires.
F. *Division 26 50 20* - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.
G. Comply with applicable requirements of ANSI/NEMA Standard Publication No. FB 1, "Fittings and Supports for Conduit and Cable Assemblies".
H. Comply with applicable MSS standard requirements pertaining to fabrication and installation practices for pipe hangers and supports.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
D. MFMA-4 - Metal Framing Standards Publication; 2004.
E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
G. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install products on or provide attachments to concrete surfaces until concrete has fully cured in accordance with *Division 03 30 00*.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for all hangers and supports.
C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
D. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.

E. Installer's Qualification Statement: Include evidence of compliance with specified requirements.
F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70.
B. Comply with applicable building code.
C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
D. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
E. Installer Qualifications for Field-Welding: As specified in *Division 05 50 00*.
F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled by Underwriter's Laboratories, Inc. (UL) as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   5. Do not use perforated pipe straps or wood for permanent support unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel or stainless steel unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
B. Materials for Metal Fabricated Supports: Comply with *Division 05 50 00*.
C. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Beam or Joist Clamp. Must be designed for symmetric loading. Clamps designed for asymmetric loading will not be acceptable. Bolted type unless otherwise indicated.
   3. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.
      c. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      d. Thomas & Betts Corporation: www.tnb.com/#sle.
      e. Substitutions: See *Division 01 60 00* - Product Requirements.
D. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
   1. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.

c. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
d. Thomas & Betts Corporation: www.tnb.com/#sle.
e. Substitutions: See *Division 01 60 00* - Product Requirements.

E. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
3. Channel Material:
a. Indoor Dry Locations: Use galvanized steel.
b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch (2.66 mm).
5. Minimum Channel Dimensions: 1-5/8-inch (41 mm) width by 13/16-inch (21 mm) height, or as required.
6. Manufacturers:
a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
b. Thomas & Betts Corporation: www.tnb.com/#sle.
c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
d. Substitutions: See *Division 01 60 00* - Product Requirements.
e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

F. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
a. Equipment Supports: 1/2-inch (13 mm) diameter.
b. Busway Supports: 1/2-inch (13 mm) diameter.
c. Single Conduit up to 1 inch (27 mm) trade size: 1/4-inch (6 mm) diameter.
d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8-inch (10 mm) diameter.
e. Trapeze Support for Multiple Conduits: 3/8-inch (10 mm) diameter.
f. Outlet Boxes: 1/4-inch (6 mm) diameter.
g. Luminaires: 1/4-inch (6 mm) diameter.
2. Where hanger rod sizes are not indicated, the load on the hanger shall be the determining factor. The maximum hanger load for mild steel hanger rods shall be as follows:

Rod Dia.	3/8"	1/2"	5/8"	7/8"	1"
Max. Load (Lbs)	610	1130	1810	3770	4960

G. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
3. Mounting Height: Provide minimum clearance of 4 inches under supported component to top of roofing.
4. Manufacturers:
a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
b. Erico International Corporation: www.erico.com/#sle.
c. PHP Systems/Design: www.phpsd.com/#sle.
d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
e. Substitutions: See *Division 01 60 00* - Product Requirements.

H. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.

6. Steel: Use beam clamps.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
    a. Where approved by Architect/Engineer.
    b. Use only threaded studs; do not use pins.
11. Hammer-driven anchors and fasteners are not permitted.
    a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
    b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction (when specified).
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Comply with MFMA-4.
    b. Channel Material: Use galvanized steel.
    c. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch (2.66 mm) minimum base metal thickness.
    d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
14. Manufacturers - Mechanical Anchors:
    a. Hilti, Inc: www.us.hilti.com/#sle.
    b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
    c. Powers Fasteners, Inc: www.powers.com/#sle.
    d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
    e. Substitutions: See *Division 01 60 00* - Product Requirements.
15. Manufacturers - Powder-Actuated Fastening Systems:
    a. Hilti, Inc: www.us.hilti.com/#sle.
    b. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
    c. Powers Fasteners, Inc: www.powers.com/#sle.
    d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
    e. Substitutions: See *Division 01 60 00* - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that mounting surfaces are ready to receive support and attachment components.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
E. Unless specifically indicated or approved by Architect/Engineer, do not provide support from suspended ceiling support system or ceiling grid.
F. Unless specifically indicated or approved by Architect/Engineer, do not provide support from roof deck.
G. Do not penetrate or otherwise notch or cut structural members without approval of Architect/Engineer.
H. Field-Welding (where approved by Architect/Engineer): Comply with Section 05 5000.
I. Equipment Support and Attachment:
    1. Use supports assembled from metal channel (strut) to support equipment as required.
    2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 3000.
5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

J. Conduit Support and Attachment: Also comply with Section 26 0533.13.
1. Surface mounted conduits shall be supported from the building structure by means of 1-hole galvanized malleable iron pipe straps, and spaced at intervals not to exceed 10' 0" apart, and also within 3'-0" of each outlet, junction box and/or pull box or cabinet.
2. Surface mounted conduits larger than 1" size, where made up with threaded couplings, shall be supported from the building structure by means of 1-hole galvanized malleable iron conduit straps spaced at intervals not to exceed the requirements of Table 346-12 of NEC.
3. Where conduit is supported by suspended hangers, the total length to the bottom of the hanger shall not exceed 12", or provision shall be made for the support of required seismic loading.
4. Where vertical runs of conduit exceed ten feet (10') in length, the Contractor shall provide a vertical run of P-1000 Unistrut to support the conduit drop. The vertical run of Unistrut shall be attached to the building roof supporting steel at the top end and to a mounting flange anchored to the concrete floor at the bottom end. The vertical conduit drop shall then be supported to the Unistrut by means of Unistrut conduit clamps spaced not more than ten feet (10') on centers. An additional conduit clamp shall be provided on the Unistrut not more than three feet (3') from each point where the conduit emanates from the Unistrut.
5. Caddy type conduit supports or any support system that does not employ screws or bolts and nuts to secure conduit or conduit support shall not be used on this project.

K. Cable Tray Support and Attachment: Also comply with *Division 26 05 23*.

L. Box Support and Attachment: Also comply with *Division 26 05 00*.
1. Support boxes from building structure in an approved manner; make support independent of conduit to which they are connected. Rod hangers shall be used where suitable. Where rod hangers are not suitable, provide U-Channel strut supports from building structure.
2. In general, switches, cabinets, panels, pull boxes, etc., that must be supported in an exposed manner from the building structure shall be supported on structural frames supported from the building structure by means of clamps or bolts.

M. Busway Support and Attachment: Also comply with *Division 26 05 25*.

N. Interior Luminaire Support and Attachment: Also comply with *Division 26 50 10*.
1. Lighting fixtures shall be securely supported from the building structure, as indicated on the drawings or as specified herein. All fixtures shall be supported, as required, to meet applicable seismic design requirements. Fixtures in furred ceilings shall be individually supported from the building structure above.

O. Exterior Luminaire Support and Attachment: Also comply with *Division 26 50 20*.

P. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

Q. Secure fasteners according to manufacturer's recommended torque settings.

R. Remove temporary supports.

S. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

DIVISION 26 05 30 - WIRING DEVICES

PART 1 GENERAL

All receptacles, breakers and switches shall be minimum 20 ampere rated, heavy duty. Code requires service outlets within 25' of every HVAC machine.

RECEPTACLES: Receptacles should be properly located throughout the building for cleaning equipment and other similar uses. A minimum of one duplex receptacle shall be provided on the interior near the top of the ladder serving the scuttle (where present) to the roof area and at each exterior mechanical equipment location. Provide a duplex receptacle and work light in all crawl spaces, open chases and attic spaces.

PE ROOMS: Minimum of one quad box outlet in each wall, with impact resistant installation. Coordinate with the IT Department for TV, Data and other technical requirements to be included in the Contract Documents. Clock location shall be provided in this room with a guard or other features to prevent damage from thrown objects.

CLASSROOMS: A receptacle is required on the wall where the short throw projectors are mounted to the wall, or in the ceiling for ceiling mounted projectors where designed. The electrical box shall be of the type suited for the type wall or ceiling.
In classrooms the receptacle directly under Promethean, Smart boards, or projector screen shall be a 20 amp 125-volt combination outlet with 2 USB 3.1 amp chargers and duplex receptacles.

1.01 SECTION INCLUDES

A. Receptacles.
B. Wall plates.
C. Service fittings.

1.02 RELATED REQUIREMENTS

A. *Division 26 05 19* - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
B. *Division 26 05 23* - Grounding and Bonding for Electrical Systems.
C. *Division 26 05 10* - Boxes for Electrical Systems.
D. *Division 26 05 50* - Identification for Electrical Systems: Identification of products and requirements.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
L. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
   3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.

4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Notify Architect/Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:
1. Do not install wiring devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
1. Wall Dimmers: Include derating information for ganged multiple devices.
C. Samples: One for each type and color of device and wall plate specified.
D. Certificates for Surge Protection Receptacles: Manufacturer's documentation of listing for compliance with UL 1449.
E. Field Quality Control Test Reports.
F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
G. Operation and Maintenance Data:
1. Wall Dimmers: Include information on operation and setting of presets.
2. GFCI Receptacles: Include information on status indicators.
H. Project Record Documents: Record actual installed locations of wiring devices.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
3. Extra Keys for Locking Switches: Two of each type.
4. Extra Wall Plates: One of each style, size, and finish.
5. Extra Flush Floor Service Fittings: Two of each type.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
D. Products: Listed, classified, and labeled as suitable for the purpose intended.
E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
D. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.
E. Provide GFCI protection for receptacles installed in kitchens.
F. Provide GFCI protection for receptacles serving electric drinking fountains.
G. Provide isolated ground receptacles for receptacles serving IDF and MDF rooms.
H. Unless noted otherwise, do not use combination switch/receptacle devices.
I. For flush floor service fittings, use tile rings for installations in tile floors.
J. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.02 WIRING DEVICE FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.
B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.

C. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.
D. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
E. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.
F. Isolated Ground Convenience Receptacles: Orange.
G. Wiring Devices Connected to Standby Power: Red with red nylon wall plate.
H. Above-Floor Service Fittings: Gray wiring devices with satin aluminum housing.

2.03 WALL SWITCHES

A. Manufacturers:
   1. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
   2. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
   3. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20and where applicable FS W-S-896; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring with separate ground terminal screw.
C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
D. Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.04 RECEPTACLES

A. Manufacturers:
   1. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
   2. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.
   4. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498and where applicable FS W-C-596; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring with separate ground terminal screw.
   2. NEMA configurations specified are according to NEMA WD 6.
C. Convenience Receptacles:
   1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
   2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
   3. Isolated Ground Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; isolated ground triangle mark on device face; single or duplex as indicated on the drawings.
   4. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
   5. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
D. GFCI Receptacles:
   1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
      a. Provide test and reset buttons of same color as device.

2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
5. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.05 WALL PLATES

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
4. Substitutions: See *Division 01 60 00* - Product Requirements.
5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.
4. Provide screwless wallplates with concealed mounting hardware where indicated.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.
D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
E. Brass Wall Plates: Brushed satin finish, factory-coated to inhibit oxidation.
F. Aluminum Wall Plates: Smooth satin finish, clear anodized, factory-coated to inhibit oxidation.
G. Chrome Wall Plates: Smooth finish, chrome plated steel.
H. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
I. Premarked Wall Plates: Factory labeled as indicated; hot stamped for nylon wall plates and engraved for metal wall plates.
J. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.
K. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.06 SERVICE FITTINGS

A. Manufacturers:
1. Basis of Design: Evolution series Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
2. Thomas & Betts Corporation: www.tnb.com/#sle.
3. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Description: Service fittings compatible with floor boxes provided under Section 26 0533.16 with components, adapters, and trims required for complete installation.
C. Floor box Service Fittings:
1. Single Service Convenience Receptacles:
a. Configuration: Two standard convenience duplex receptacle.
2. Dual Service Combination Outlets:
a. Configuration:
1) Power: Two standard convenience duplex receptacle.
2) Communications: Two 1-inch bushed openings.
b. Provide barriers to separate line and low voltage compartments.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
D. Verify that final surface finishes are complete, including painting.
E. Verify that floor boxes are adjusted properly.
F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.
B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.
    1. Mounting Heights: Unless otherwise indicated, as follows:
        a. Wall Switches: 48 inches (1200 mm) above finished floor.
        b. Receptacles: 18 inches (450 mm) above finished floor or 6 inches (150 mm) above counter.
    2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
    3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
    4. Locate wall switches on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect/Engineer to obtain direction prior to proceeding with work.
    5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
C. Install wiring devices in accordance with manufacturer's instructions.
D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.
F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
H. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.
I. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
J. Unless otherwise indicated, GFCI receptacles may be connected to provide feed-through protection to downstream devices. Label such devices to indicate they are protected by upstream GFCI protection.
K. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
L. Install wiring devices plumb and level with mounting yoke held rigidly in place.
M. Install wall switches with OFF position down.
N. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

O. Do not share neutral conductor on branch circuits.
P. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
Q. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
R. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
S. Identify wiring devices in accordance with Section 26 0553.

3.04 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Perform field inspection, testing, and adjusting in accordance with *Division 01 40 00*.
C. Inspect each wiring device for damage and defects.
D. Operate each wall switch with circuit energized to verify proper operation.
E. Test each receptacle to verify operation and proper polarity.
F. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
G. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.
B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect/Engineer.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

DIVISION 26 05 35 - SERVICE ENTRANCE

GENERAL

The primary transformer and primary wiring should be owned and maintained by the utility serving the school, if possible. Any primary system costs that exceed the utility's contribution should be included in the general contract. The main distribution panel shall be sized to provide adequate capacity for all current and proposed future expansion.

The designer shall coordinate with the power supplier and indicate and/or specify all requirements for:

- Point of service
- Division of work (contractor and power company)

Fault current: Overcurrent device(s) shall have interrupting capacity in excess of available fault current throughout system.

DIVISION 26 05 40 – PANELBOARDS

PART 1 GENERAL

The main panel should not be located in an area subject to moisture, excessive heat, or the possibility of physical damage. Do not locate main panels below grade or any panels in inaccessible locations. For projects at existing buildings, ensure that the existing panels are grounded as required by Code.

TRANSFORMERS: All transformers of any voltage **shall not contain any aluminum** components. Only in special conditions and with written approval by Owner will aluminum be allowed.

PANEL BOARDS: All panel boards shall have a copper bus. All panel boards shall be provided with main breakers, including sub-panel boards that are served from another panel board except where sub-panel boards are located in the same room as the panel board serving them. NEC required clearances shall be provided around all panel boards. Show a clearance detail on drawings for clarification. Lighting panel boards shall contain only lighting circuits. All other loads such as receptacles, mechanical/plumbing equipment, etc. shall be served from separate panel board(s).
Provide dedicated protected circuits serving computers.

All panel boards shall be specified for 25% minimum spare electrical and physical capacity above the anticipated demand load. Include spare 20-amp breakers in each panel board “knockout” and label as spare.

All distribution panels shall have their circuits clearly and accurately marked. Specify typed directories in all panel boards. Room names and numbers shall match final signage used at the site.
Specify screwed-on laminated plastic identification labels on cover of all panel boards.
Key all panel door locks alike.

1.01 SECTION INCLUDES

A. Power distribution panelboards.
B. Lighting and appliance panelboards.
C. Overcurrent protective devices for panelboards.

1.02 DESCRIPTION OF WORK

A. Extent of panelboard and enclosure work, including cabinets and cutout boxes, as indicated by drawings and schedules.
B. Types of panelboards and enclosures in this section include the following:
    1. Power distribution panelboards.
    2. Lighting and appliance panelboards.
C. Refer to the drawings and other Division 26 sections for cable/wire, connectors and electrical raceway work required in conjunction with panelboards and enclosures.

1.03 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Concrete equipment pads.
B. *Division 26 05 23* - Grounding and Bonding for Electrical Systems.
C. *Division 26 05 25* - Hangers and Supports for Electrical Systems.
D. *Division 26 05 50* - Identification for Electrical Systems: Identification of products and requirements.
E. *Division 26 09 10* - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.
F. Section 26 4300 - Surge Protective Devices.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
    1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
    2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
    3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
    4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
    5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
    1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
    1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
    2. Include wiring diagrams showing all factory and field connections.
D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.

E. Field Quality Control Test Reports.
F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
G. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See *Division 01 60 00* - Product Requirements, for additional provisions.
2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.
D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:
1. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

1.09 SEISMIC QUALIFICATIONS

A. Provide Seismic tested equipment as follows:
1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the International Building Code (IBC) with seismic values as determined by structural sheet S0.1.
B. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil/structural engineer in the state of the project. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
1. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
C. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualifications shall be considered achieved when the capability of the equipment meets or exceeds the specified response spectra.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Siemens Industry, Inc: www.usa.siemens.com.
B. Eaton Corporation: www.eaton.com.
C. General Electric Company: www.geindustrial.com.
D. Schneider Electric; Square D Products: www.schneider-electric.us.
E. Engineer Approved Equal.
F. Substitutions: See *Division 01 60 00* - Product Requirements.

G. Source Limitations: Furnish panelboards and associated components produced by a single manufacturer and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet (2,000 m).
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with *Division 26 05 55*.
   2. Listed series ratings are not acceptable.

D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
   3. Provide separate isolated/insulated ground bus where indicated.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
      b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
      c. Provide removable end walls for NEMA Type 1 enclosures.
      d. Provide painted steel boxes for surface-mounted panelboards, finish to match fronts.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
      c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
   4. Lockable Doors: All locks keyed alike unless otherwise indicated.

I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

J. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with *Division 26 40 00*, list and label panelboards as a complete assembly including surge protective device.

K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
   1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensors where applicable.
   2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
      a. Use zero sequence ground fault detection method unless otherwise indicated.
      b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
      c. Provide zone selective interlocking capability where indicated, capable of

communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.

L. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
M. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs and feeders as indicated or as required to interconnect sections.
N. Load centers are not acceptable.
O. Provide the following features and accessories where indicated or where required to complete installation:
    1. Feed-through lugs.
    2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type (unless otherwise noted), and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
B. Products:
    1. Square D Company; Type "HCM".
    2. Eaton Corporation; Type "PRL4".
    3. General Electric Company; Type "CCB".
    4. Substitutions: See *Division 01 60 00* - Product Requirements.
C. Conductor Terminations:
    1. Main and Neutral Lug Material: Copper suitable for terminating copper conductors only.
    2. Main and Neutral Lug Type: Mechanical.
D. Bussing:
    1. Phase and Neutral Bus Material: Copper.
    2. Ground Bus Material: Copper.
E. Circuit Breakers:
    1. Provide bolt-on type.
    2. Provide thermal magnetic circuit breakers unless otherwise indicated.
    3. Provide electronic trip circuit breakers where indicated.
F. Enclosures:
    1. Provide surface-mounted or flush-mounted enclosures as indicated.
    2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
    3. Provide metal circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
B. Products:
    1. Square D Company; Type "NF' or NQOD".
    2. Eaton Corporation; Type "PRL 1a 2a or 3a.
    3. General Electric Company; Type "AE" or "AQ".
    4. Substitutions: See *Division 01 60 00* - Product Requirements.
C. Conductor Terminations:
    1. Main and Neutral Lug Material: Copper suitable for terminating copper conductors only.
    2. Main and Neutral Lug Type: Mechanical.
D. Bussing:
    1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
    2. Phase and Neutral Bus Material: Copper.
    3. Ground Bus Material: Copper.
E. Circuit Breakers: Thermal magnetic bolt-on type.
F. Enclosures:
    1. Provide surface-mounted or flush-mounted enclosures as indicated.

2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide metal circuit directory holder mounted on inside of door.

G. Provide column-width panelboards where indicated.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
   a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      1) 10,000 rms symmetrical amperes at 208 VAC.
      2) 14,000 rms symmetrical amperes at 480 VAC.
   b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
   a. Provide mechanical lugs.
   b. Lug Material: Copper suitable for terminating copper conductors only.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
   b. Provide interchangeable trip units where indicated.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   a. Provide the following field-adjustable trip response settings:
      1) Long time pickup, adjustable by setting dial.
      2) Long time delay.
      3) Short time pickup and delay.
      4) Instantaneous pickup.
      5) Ground fault pickup and delay where ground fault protection is indicated.
   b. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
   c. Provide communication capability where indicated: Compatible with system indicated on the drawings.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
   b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
   c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
   d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
   e. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
8. Do not use handle ties in lieu of multi-pole circuit breakers.
9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.

10. Provide the following features and accessories where indicated or where required to complete installation:
    a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.
11. All panelboard covers shall have a means to accommodate all lock out/tag out equipment. In addition, doors shall have key locking devices with all locks using identical keys on the project.

2.06 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive panelboards.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
E. Provide required support and attachment in accordance with *Division 26 05 25*.
F. Install panelboards plumb.
G. Feeders to 3-phase panelboards shall be connected so as to provide A-B-C phase relationship at panel bus, (left-to-right, when facing the front of the panel).
H. Install panelboards where indicated on the drawings.
I. Anchor surface mounted panels to the building structure by means of U-channel strut system or approved equal.
J. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
K. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.
L. Mount floor-mounted power distribution panelboards on properly sized 4 inch (100 mm) high concrete pad constructed in accordance with *Division 03 30 00*.
M. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor as indicated.
N. Provide grounding and bonding in accordance with *Division 26 05 23*.
    1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
    2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
O. Install all field-installed branch devices, components, and accessories.
P. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
Q. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
R. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to *Division 26 05 55*.
S. Provide filler plates to cover unused spaces in panelboards.
T. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated or required. Also provide for the following:
    1. Emergency and night lighting circuits.
    2. Fire detection and alarm circuits.
    3. Communications equipment circuits.
    4. Intrusion detection and access control system circuits.

5. Video surveillance system circuits.

U. Identify panelboards in accordance with *Division 26 05 50*.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform inspection, testing, and adjusting in accordance with *Division 01 40 00*.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

E. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1where required. Tests listed as optional are not required except for the following:

1. Perform insulation-resistance tests on all control wiring with respect to ground.
2. Test functions of the trip unit by means of secondary injection.

F. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

G. Test GFCI circuit breakers to verify proper operation.

H. Test AFCI circuit breakers to verify proper operation.

I. Test shunt trips to verify proper operation.

J. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

DIVISION 26 05 45 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. This section is a Division 26 Basic Materials and Methods section and is part of each Division 26 section making reference to seismic restraints.

1.02 DESCRIPTION OF WORK

A. The extent of the seismic restraints under this section is intended to provide multi-directional bracing and support for all electrical equipment to resist lateral and vertical forces of earthquake loads in accordance with section 1613 of the International Building Code, latest adopted edition and as listed below.

1.03 WORK AND EQUIPMENT NOT REQUIRING SPECIAL SEISMIC RESTRAINTS

A. The requirement for Seismic restraints includes the assigned importance factor (Ip), with Ip=1.5, the following will not require special seismic restraints:

1. Conduit less than 2-1/2" inside diameter.
2. Conduit larger than 2-1/2" inside diameter where supported on hangers not more than 12" long.

B. Where the assigned importance factor (Ip)=1.5 per Table –1.5-2 per ASCE 7 or as required as noted in drawings. Further analysis is required for providing restraints to assure reliable operation of facility or portion of the facility with the higher performance requirement.

1.04 GENERAL REQUIREMENTS

A. With Ip=1.5 for the facility, transverse and longitudinal braces spacings, embedment, and rod type shall be as dictated by calculations stamped by a registered Professional Engineer as retained by the Contractor per Section 1.05 herein.

1.05 SEISMIC CERTIFICATION AND ANALYSIS

A. Seismic restraint calculations must be provided by the Contractor for all connections of equipment to the structure. Calculations must be stamped by a registered Professional Engineer as retained by the Contractor with at least five years of seismic design experience, licensed in the state of the job location.

B. All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer as retained by the Contractor with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 45° to the weakest mode.

C. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. Where available in the construction documents, Structural Sheet S0.1 describes the ASCE 7 seismic design criteria and IBC Chapter 16 requirements for the project. Where that sheet is not provided, the Local Building Department should be contacted to provide the seismic design criteria and requirements, ASCE 7 and IBC are coordinated. All seismic restraint devices shall be designed to accept, without failure, the seismic design criteria detailed below.

1.06 SEISMIC DEISIGN CRITERIA

A. Provide Seismic tested equipment as follows:

1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the 20xx International Building.

B. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil/structural engineer in the state of the project. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

C. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualifications shall be considered achieved when the capability of the equipment meets or exceeds the specified response spectra.

PART 2 PRODUCTS

2.01 SEISMIC MATERIALS

A. Seismic restraint materials shall be as manufactured by B-Line Systems or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION OF SEISMIC MATERIALS

A. Furnish and install seismic restraints as required for all electrical work based on the following earthquake load design data in accordance with Section 1613 of the International Building Code, latest edition:

1. Earthquake soil acceleration coefficients as defined in the International Building Code or as shown on Sheet S0.1 as applicable.
2. Seismic design criteria as indicated in Paragraph 1.05C in this document.

B. All electrical equipment shall be attached to the building structure by means that will resist the necessary lateral and vertical forces from an earthquake with the characteristics listed above.

C. Coordinate size, shape, reinforcement and attachment of all housekeeping pads supporting vibration/seismically rated equipment. Concrete shall have a minimum compressive strength of 3,000 psi or as specified by the project engineer. Coordinate size, thickness, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation and seismic restraint device manufacturer to ensure adequate space, embedment and prevent edge

breakout failures. Pads and piers must be adequately doweled in to structural slab.

D. Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors. Refer seismic restraint manufacturer's written instructions.
E. Attach conduit to the trapeze per seismic restraint manufacturer's design. Install cables so they do not bend across sharp edges of adjacent equipment or building structures.
F. Do not brace or support equipment to separate portions of the structure that may act differently in response to an earthquake. For example, do not connect a Transverse restraint to a wall and then a Longitudinal restraint to either a floor/ceiling/roof at the same braced location.
G. Install vertical braces to stiffen hanger rods and prevent buckling per seismic restraint manufacturer's design. Clamp vertical brace to hanger rods. Requirements apply equally to hanging equipment. Do not weld vertical braces to hanger rods.
H. Attachment to structure for suspended equipment and conduit: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
I. Concrete Anchor Bolts:
   Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre- or post-tensioned tendons, electrical and telecommunications conduit, and gas lines.
   1. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   2. Mechanical Anchors: Protect threads from damage during anchor installation.
   3. Adhesive Anchors: Clean holes to remove loose material and drilling dust per manufactures instructions prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   4. Set anchors to manufacturer's recommended torque, using a torque wrench.
J. Base Mounted Equipment: All base mounted equipment that meets any of the following conditions requires attachments and seismic restraints:
   1. Connections to or containing hazardous material,
   2. With an overturning moment,
   3. Weight greater than 400 lbs.,
   4. Mounted on a stand 4 ft. or more from the floor.
   5. For importance factors greater than 1.0 all base mounted items require seismic restraints regardless of the above notes.
K. Rigid Mounted Equipment:
   1. Anchor floor and wall mounted equipment to the structure as per the stamped seismic certifications / drawings.
   2. Suspended equipment shall be restrained using seismic cable restraints, or struts, and hanger rods as per the stamped seismic certifications / drawings.
L. Vibration Isolated Equipment:
   1. Seismic control shall not compromise the performance of noise control, vibration isolation or fire stopping systems.
   2. Equipment supported by vibration-isolation hangers shall be detailed and installed with approximately a 1/8" gap between the isolation hangers and the structure. Isolators at restraint locations must be fitted with uplift limit stops.
M. Electrical Systems:
   1. All electrical systems are to be restrained to meet code requirements.
      a. All piping associated with "Life Safety Systems" shall always have an importance factor of 1.5. Seismic restraint requirements / exemptions vary with code and seismic acceleration - see specific code and comply with applicable restraint requirements.

3.02 INSPECTION AND CERTIFICATION

A. The contractor shall notify the local representative of the seismic restraint materials manufacturer prior to installing any seismic restraint devices. The contractor shall seek the representative's guidance in any installation procedures with which he/she is unfamiliar.

Document notification and topics of guidance. Include contact references.

1. The installing contractor shall submit a report upon request to the Architect indicating that all seismic restraint material has been properly installed, or steps that are to be taken by the contractor to properly complete the seismic restraint work as per the specifications.

DIVISION 26 05 50 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.
B. Identification nameplates and labels.
C. Wire and cable markers.
D. Voltage markers.
E. Underground warning tape.
F. Warning signs and labels.

1.02 DESCRIPTION OF WORK

A. Types of electrical identification include the following:
   1. Underground cable marker tape.
   2. Conductor identification.
   3. Danger signs.
   4. Equipment/system identification signs.

1.03 RELATED REQUIREMENTS

A. *Division 26 05 19* - Low-Voltage Electrical Power Conductors and Cables
B. *Division 26 05 30* - Wiring Devices: Device and wall plate finishes.

1.04 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2023.
B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.
C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2015.
E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.06 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittals procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
D. Samples:
   1. Provide if requested.

   Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.07 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.08 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components as follows:
   a. Switchboards:
      1) Identify ampere rating.
      2) Identify voltage and phase.
      3) Identify power source and circuit number. Include location.
      4) Use identification nameplate to identify main overcurrent protective device.
      5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
   b. Panelboards:
      1) Identify ampere rating.
      2) Identify voltage and phase.
      3) Identify power source and circuit number. Include location.
      4) Identify main overcurrent protective device. Use identification nameplate.
      5) Use typewritten circuit directory. Identify spares and spaces.
      6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
   c. Transformers:
      1) Identify kVA rating.
      2) Identify voltage and phase for primary and secondary.
      3) Identify power source and circuit number. Include location.
      4) Identify load(s) served..
   d. Enclosed switches, circuit breakers, and motor controllers:
      1) Identify voltage and phase.
      2) Identify power source and circuit number. .
      3) Identify load(s) served. .
   e. Time Switches:
      1) Identify load(s) served and associated circuits controlled.
   f. Enclosed Contactors:
      1) Identify ampere rating.
      2) Identify voltage and phase.
      3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
      4) Identify coil voltage.
      5) Identify load(s) and associated circuits controlled. Include location.
   g. Transfer Switches:
      1) Identify voltage and phase.
      2) Identify power source and circuit number for both normal power source and standby power source. Include location.
      3) Identify load(s) served. Include location.
      4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.
2. Service Equipment:
   a. Use identification nameplate to identify each service disconnecting means.
   b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
3. Standby Power System Equipment:
   a. Use identification nameplate to identify emergency system equipment in accordance with NFPA 70.
   b. Use identification nameplate at each piece of service equipment to identify type and

location of on-site standby power sources.

4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
5. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
6. Use identification labels to identify spare conduits at each end.
7. Use underground warning tape to identify underground raceways.
8. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
   a. Service equipment.
   b. Elevator Control Panels.

B. Use OSHA 1910.145 warning signs to identify electrical hazards for equipment compartments. Electrical Rooms, and enclosures containing Electrical Equipment with the word message "DANGER: HIGH VOLTAGE: KEEP OUT". Signs to be 8"x11" size, danger legend white letters on red background with black border, high voltage, red letters on white background.

C. Use warning labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER: Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing".

D. Identification for Boxes:
   1. Fire Alarm System: Red.
   2. Identification for Communications Devices: Comply with *Division 27 10 00*.
   3. Wiring Device and Wallplate Finishes: Comply with *Division 26 05 30*.
   4. Use identification label to identify fire alarm system devices.
      a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.

E. Identification for Luminaires:
   1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
   1. Manufacturers:
      a. Brimar Industries, Inc: www.brimar.com/#sle.
      b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
      c. Seton Identification Products: www.seton.com.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Materials:
      a. Indoor Clean, Dry Locations: Use plastic nameplates.
      b. Outdoor Locations: Use plastic nameplates suitable for exterior use.
   3. Plastic Nameplates: Two-layer or three-layer laminated acrylic with beveled edges; minimum thickness of 1/8 inch (3 mm); 1/4-inch engraved text.
   4. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.

B. Identification Labels:
   1. Manufacturers:
      a. Brady Corporation: www.bradyid.com.
      b. Brother International Corporation: www.brother-usa.com/#sle.
      c. Panduit Corp: www.panduit.com/#sle.
      d. Substitutions: See *Division 01 60 00* - Product Requirements.
   2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
      a. Use only for indoor locations.
   3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
   1. Minimum Size: 3 inches (76 mm) or as required.

2. Legend:
    a. System designation where applicable:
        1) Emergency Power System: Identify with text "EMERGENCY".
        2) Fire Alarm System: Identify with text "FIRE ALARM".
    b. Equipment designation or other approved description.
    c. Other information as indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
    a. System Designation: 1/2 inch (13 mm).
    b. Equipment Designation: 1/4 inch (6 mm).
    c. Other Information: 1/4 inch (6 mm).
    d. Exception: Provide minimum text height of 1 inch (25 mm) for equipment located more than 10 feet (3.0 m) above floor or working platform.
5. Color:
    a. Normal Power System: White text on black background.
    b. Emergency Power System: White text on red background.

D. Format for General Information and Operating Instructions:
1. Minimum Size: 4 inches (100 mm).
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch (6 mm).
5. Color: White text on black background unless otherwise indicated.
    a. Exceptions:
        1) Provide white text on red background for general information or operational instructions for emergency systems.
        2) Provide white text on red background for general information or operational instructions for fire alarm systems.

E. Format for Caution and Warning Messages:
1. Minimum Size: 4 inches (100 mm).
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch (6 mm).
5. Color: White text on yellow background unless otherwise indicated.

F. Format for Fire Alarm Device Identification:
1. Minimum Size: 1/2 inch (13 mm) by 1.5 inches (38 mm).
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/8 inch (3 mm).
5. Color: White text on red background.

2.03 WIRE AND CABLE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradyid.com.
2. HellermannTyton: www.hellermanntyton.com.
3. Panduit Corp: www.panduit.com/#sle.
4. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl self-laminating type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
1. Do not use handwritten text.

F. Minimum Text Height: 1/8 inch (3 mm).

G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com.
   2. Brimar Industries, Inc: www.brimar.com/#sle.
   3. Seton Identification Products: www.seton.com.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl type markers.
D. Minimum Size:
   1. Markers for Equipment: 1 1/8 by 4 1/2 inches (29 by 110 mm).
   2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
   3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches (29 by 110 mm).
   4. Markers for Junction Boxes: 1/2 by 2 1/4 inches (13 by 57 mm).
E. Legend:
   1. Markers for Voltage Identification: Highest voltage present.
   2. Markers for System Identification:
      a. Emergency Power System: Text "EMERGENCY".
      b. Other Systems: Type of service.
F. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com.
   2. Seton Identification Products: www.seton.com.
   3. Thomas and Betts: www.tnb.com.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
C. Foil-backed Detectable Type Tape: 3 inches (76 mm) wide, with minimum thickness of 5 mil (0.1 mm), unless otherwise required for proper detection.
D. Legend: Type of service, continuously repeated over full length of tape.
E. Color:
   1. Tape for Buried Power Lines: Black text on red background.
   2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 WARNING SIGNS AND LABELS

A. Manufacturers:
   1. Brimar Industries, Inc: www.brimar.com/#sle.
   2. Clarion Safety Systems, LLC: www.clarionsafety.com.
   3. Seton Identification Products: www.seton.com.
   4. Substitutions: See *Division 01 60 00* - Product Requirements.
B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
C. Warning Signs:
   1. Materials:
      a. Indoor Dry, Clean Locations: Use factory pre-printed rigid aluminum signs.
      b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
   2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
   3. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.
D. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
      a. Do not use labels designed to be completed using handwritten text.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.

3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Conduits: Legible from the floor.
   8. Boxes: Outside face of cover.
   9. Conductors and Cables: Legible from the point of access.
   10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using self-tapping stainless steel screws and to interior surfaces using epoxy cement.
   1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 6-8 inches below finished grade.

G. Secure rigid signs using self-tapping stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

3.03 APPLICATION AND INSTALLATION REQUIREMENTS

A. Install signs or nameplates at locations indicated or where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of the equipment.

3.04 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

DIVISION 26 05 55 - POWER SYSTEM ANALYSIS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or a professional electrical engineering firm.

B. Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E - Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to IEEE 1584.

C. The studies shall include all new electrical distribution equipment supplied under this contract.
   1. Include stanby power system distribution equipment.

1.02 RELATED SECTIONS

A. *Division 26 00 00*: Common Work for Electrical

B. *Division 26 05 40*: Panelboards

C. *Division 26 24 13*: Switchboards

1.03 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   1. IEEE 141 - Recommended Practice for Electric Power Distribution and Coordination of

Industrial and Commercial Power Systems
2. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 241 - Recommended Practice for Electric Power Systems in Commercial Buildings
5. IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
6. IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):
1. ANSI C57.12.00 - Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 - Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 - Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

C. The National Fire Protection Association (NFPA)
1. NFPA 70 - National Electrical Code
2. NFPA 70E - Standard for Electrical Safety in the Workplace

1.04 SUBMITTALS FOR REVIEW/APPROVAL

A. Submit a preliminary short-circuit and protective device coordination study to the design engineer prior to receiving final approval of the shop drawings and/or prior to release of equipment drawings for manufacturing. The preliminary study shall use estimated feeder lengths from the Div 26 subcontractor. The study shall be complete with fault analysis, coordination curves for each branch of the riser.

B. Submit the final short-circuit and protective device coordination analysis at the end of the construction cycle when circuits are installed and all equipment is on site and/or installed such that complete and accurate data may be obtained. Update the preliminary study with installed feeder lengths.

C. Submit the arc flash hazard analysis at the end of the construction cycle when all circuits are installed and all equipment is on site and/or installed such that complete and accurate data may be obtained.

1.05 SUBMITTALS FOR CONSTRUCTION

A. The results of the final short-circuit, protective device coordination, and arc flash hazard (if required) analysis studies shall be summarized in a final report. No more than two (2) bound color copies of the complete final report shall be submitted. An additional copy of the short-circuit input and output data shall be provided on CD in unsecured color PDF format at all submission stages.

B. At the owner's option, the contractor is required to provide the study project files to the Owner in electronic format including all project files, libraries, etc. to allow the owner to update and to print additional copies, labels, etc.

C. If the owner does not use the applicable computer program, a copy of the computer analysis software viewer program is required to accompany the electronic project files, to allow the Owner to review all aspects of the project and print arc flash labels, one-line diagrams, etc.

D. The report shall include the following sections:
1. Executive Summary.
2. Descriptions, purpose, basis and scope of the study.
3. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short circuit duties.
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, and fuse selection.
5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
6. Details of the incident energy and flash protection boundary calculations.
7. Recommendations for system improvements, where needed.
8. One line diagram.
9. Equipment specific arc flash labels.

E. If the power systems study submittal is not approved following the second submittal, the contractor shall pay the Project Engineer $200.00 per hour to review additional submittals until the study is approved.

1.06 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
B. The Registered Professional Electrical Engineer shall be a full-time employee of the electrical equipment manufacturer or a professional electrical engineering firm.
C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
D. The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting a detailed plan outlining the steps to be taken to ensure a proper outcome (if required).

1.07 COMPUTER ANALYSIS SOFTWARE

A. The studies shall be performed using the latest revision of the SKM Systems Analysis Power*Tools for Windows (PTW) software program. Other commercially available products may be considered under certain circumstances.

PART 2 - PRODUCT

2.01 STUDIES

A. Furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or a professional electrical engineering firm.
B. Furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace.

2.02 DATA COLLECTION

A. Electrical Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination, and arc flash hazard analysis studies shall furnish the Electrical Contractor with a list of required data immediately after award of the contract. The Electrical Contractor shall expedite collection of the data to ensure completion of the studies as required.
B. The engineer performing the study shall make at least one job site visit before completion of the final study to familiarize himself/herself with the project to ensure that the provided data is accurate.
C. Source contribution shall include present and future motors and generators.
D. Load data utilized shall include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.

2.03 SHORT-CIRCUIT STUDY

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141.
B. Estimated conductor lengths and utility data may be used for the preliminary study.
C. Actual installed conductor lengths, test and/or nameplate data for all generators, transformers, motors 50 HP and larger, capacitors, reactors, or other equipment that may affect the study must be used for the final study.
D. Actual utility fault current and X/R ratio shall be used. Infinite bus calculation is not acceptable.
E. The pre-fault bus voltage shall be the highest reported by the utility for past 5 years. If unavailable, 1.05 per unit shall be used.
F. Provide the following:
    1. Calculation methods and assumptions.
    2. Selected base per unit quantities.
    3. One line diagram of the system being evaluated.
    4. Utility impedance data, including the maximum and minimum 3 phase and line-to-ground fault current available, nominal, maximum, and minimum voltage, 3 phase X/R ratio, and line-to-ground X/R ratio.
    5. Utility protective device settings including recloser if used.
    6. Motor fault contribution characteristics.
    7. Generator fault contribution characteristics.

8. Tabulations of calculated quantities.
9. Results, conclusions, and recommendations.

G. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
1. Electric utility's supply termination point
2. Incoming switchgear
3. Low voltage switchgear.
4. Motor control centers.
5. Standby generators and automatic transfer switches.
6. Branch circuit panelboards.
7. Other significant locations throughout the system.

H. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

I. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short circuit ratings.
2. Adequacy of switchgear, switchboards, disconnects, transfer switches, motor control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Notify Owner, in writing, of any existing circuit protective devices improperly rated for the calculated available fault current.

2.04 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs. No more than 5 devices shall be shown on any plot.

B. Include on each TCC graph, a complete title, applicable notes, and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable:
1. Electric utility's overcurrent protective device.
2. Medium voltage equipment overcurrent relays.
3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves. The frequent fault portion of the damage curve should not be shown unless the transformer feeds overhead lines. The shifted curve for line-to-ground faults on the secondary side shall be shown on the ground fault plot.
6. Conductor damage curves.
7. Ground fault protective devices shall be shown on separate TCC plots. The first phase overcurrent relay and any negative sequence relays on the primary side of a delta-wye transformer shall be shown.
8. Pertinent motor starting characteristics, motor damage points, and overload relay.
9. Pertinent generator short-circuit decrement curve and generator damage point.
10. The largest feeder circuit breaker in each applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.05 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed in accordance to IEEE 1584.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, panelboards, variable frequency drives, electrical equipment associated with mechanical equipment, etc), where work could be performed on energized parts.

C. The Arc-Flash Hazard Analysis shall include all significant locations in 208-volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.
E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off).
G. Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
H. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
    1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
    2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
I. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
J. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
K. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
L. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.06 REPORT SECTIONS

A. Input data shall include, but not be limited to the following:
    1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
    2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, KVA rating, impedance, % taps and phase shift.
    3. Reactor data, including voltage rating, and impedance.
    4. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X"d), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
    5. Motor contribution data (induction motors and synchronous motors), including short circuit reactance, rated horsepower or KVA, rated voltage, and X/R ratio.
B. Short-Circuit Output Data shall include, but not be limited to the following reports:
    1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
        a. Voltage
        b. Calculated fault current magnitude and angle

c. Fault point X/R ratio
d. Equivalent impedance

2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
   a. Voltage
   b. Calculated symmetrical fault current magnitude and angle
   c. Fault point X/R ratio
   d. Calculated asymmetrical fault currents
3. Based on fault point X/R ratio
4. Based on calculated symmetrical value multiplied by 1.6
5. Based on calculated symmetrical value multiplied by 2.7
   a. Equivalent impedance
6. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
   a. Voltage
   b. Calculated symmetrical fault current magnitude and angle
   c. Fault point X/R ratio
   d. No AC Decrement (NACD) Ratio
   e. Equivalent impedance
   f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis
   g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis
7. Equipment evaluation table including but not limited to AIC rating, X/R ratio, actual fault current, percent of actual to rated fault current, derated value.

C. Recommended Protective Device Settings:
   1. Phase and Ground Relays:
      a. Current transformer ratio
      b. Current setting
      c. Time setting
      d. Instantaneous setting
      e. Recommendations on improved relaying systems, if applicable.
   2. Special purpose relays
      a. Provide settings for all functions provided by special purpose relays such differential, reverse power, directional overcurrent, negative sequence, current unbalance, and multi-function relays for main and tie circuit breakers, generator management, transformer protection, feeder protection, motor protection, etc.
   3. Circuit Breakers:
      a. Adjustable pickups and time delays (long time, short time, ground)
      b. Adjustable time-current characteristic
      c. Adjustable instantaneous pickup
      d. Recommendations on improved trip systems, if applicable.

D. Incident energy and flash protection boundary calculations
   1. Arcing fault magnitude
   2. Protective device clearing time
   3. Duration of arc
   4. Arc flash boundary
   5. Working distance
   6. Incident energy
   7. Hazard Risk Category
   8. Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.01 FIELD ADJUSTMENT

A. Div 16 subcontractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study at the preliminary and final stages. Field adjustments to be completed by the electrical contractor in conjunction with Power Systems Analysis engineer. Provide tabulated check list as settings are confirmed to include date, time and personnel involved. Submit to engineer at the appropriate stages.

B. Make minor modifications to equipment as required to provide for conformance with short circuit and protective device coordination studies.
C. Notify Owner in writing of any required major equipment modifications.

3.02 ARC FLASH WARNING LABELS

A. The engineer of the Arc Flash Hazard Analysis shall provide a 3.5 in. x 5 in., unless directed otherwise by owner, thermal transfer type label of high adhesion polyester for each work location analyzed.
B. All labels will be based on recommended overcurrent device settings and will be provided to owner after the results of the analysis have been presented and after any system changes, upgrades, or modifications have been incorporated in the system.
C. The label shall include the following information, at a minimum:
   1. Location designation
   2. Nominal voltage
   3. Flash protection boundary
   4. Hazard risk category
   5. Incident energy
   6. Working distance
   7. Engineering report number, revision number and issue date.
D. Labels shall be machine printed, with no field markings.
E. Arc flash labels shall be provided for the following equipment as a minimum and all labels shall be based on recommended overcurrent device settings and worst case incident energy available.
   1. For each 480 and applicable 208-volt panelboard, provide one arc flash label.
   2. For each low voltage switchboard, provide one arc flash label. If the switchboard has a main breaker or fuse, provide two labels, one for line side compartments and one for load side compartments.
   3. For all other electrical and mechanical equipment specified in 2.05(B), provide one arc flash label.
   4. Where equipment is fed from a standby source and results in a higher incident energy level, provide two labels, one for the normal source and one for the emergency source.
F. Labels shall be field installed by the electrical contractor in conjunction with the Arc Flash Study engineer.

3.03 ARC FLASH TRAINING

A. The engineer of the Arc Flash Hazard Analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent.

DIVISION 26 05 60 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. The work under this Section is subject to requirements of the Contract Documents including the Owner's General Conditions and articles of the Construction Manager's General Conditions.
B. General commissioning requirements are detailed in Division 01.
C. The commissioning process does not reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product in accordance with the Contract Documents.
D. This section shall in no way diminish the responsibility of the Division 26 Contractors, Subs and Suppliers in performing all aspects of work and testing as outlined in the contract documents. Any requirements outlined in this section are in addition to requirements outlined in Division 01 and 26 Specifications.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

B. The requirements in this section are in addition to those specifically outlined in:
   1. *Division 01 80 00* – Minimum Owner Training Requirements
   2. *Division 01 90 00* – General Commissioning Requirements

1.3 ELECTRICAL EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

A. The following equipment and systems shall be commissioned as part of this project. All general references to equipment and systems within this document refer only to those identified below:
   1. Interior Lighting Controls
   2. Exterior Lighting Controls
   3. Normal Power Distribution (through first level of 480V Distribution Boards)

1.4 REFERENCES

A. Refer to *Division 01 90 00* for applicable references for work associated with this section.

1.5 DEFINITIONS & ABBREVIATIONS

A. Refer to *Division 01 90 00* for definitions and abbreviations for terms in this section.

1.6 COMMISSIONING TEAM

A. Refer to *Division 01 90 00* for commissioning team members.

1.7 COMMISSIONING SUBMITTALS

A. Refer to *Division 01 90 00* for additional information regarding commissioning submittals.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

B. Refer to *Division 01 90 00* for additional test equipment requirements.

C. If not otherwise specified, the following minimum requirements apply.
   1. Voltage measuring equipment (true RMS) shall have a certified accuracy of ±2% of reading with a resolution of 1V.
   2. Amperage measuring equipment shall have a certified accuracy of ±2% of reading with a resolution of 0.1A.

PART 3 EXECUTION

3.1 COMMISSIONING PROCESS OVERVIEW

A. Refer to *Division 01 90 00* for an overview of the commissioning process.

3.2 ROLES AND RESPONSIBILITIES

A. Refer to *Division 01 90 00* for roles and responsibilities of additional team members.

B. Electrical Contractor Responsibilities
   1. Include costs for all commissioning requirements in contract price.
   2. Provide all necessary certified technicians, tools, meters, and protective equipment to safely and accurately record measurements of energized components.
   3. For lighting controls systems, provide factory trained technician who is familiar with the project specific programming to assist with FPTs.
   4. Review all PFC and FPT test procedures to confirm applicability of required information.
   5. Any tasks indicated within the PFCs and FPT test procedures do not override any other start-up and checkout tasks identified in Division 26. It is the EC's responsibility to ensure the system is fully operational.

3.3 SCHEDULING AND COORDINATION

A. Refer to Section *Division 01 90 00* for scheduling and coordination requirements.

3.4 PRE-FUNCTIONAL CHECKLISTS

A. Refer to *Division 01 90 00* for PFC requirements.

B. Execution:
   1. The EC shall assist the CxA with documenting PFC information for any energized equipment. EC shall provide appropriate personnel, equipment, and PPE to gather required.

3.5 START-UP AND INITIAL CHECKOUT

A. Refer to *Division 01 90 00* for Start-Up and Checkout requirements.

3.6 FUNCTIONAL PERFORMANCE TESTS

A. Refer to *Division 01 90 00* for FPT requirements.

B. Execution:

1. The EC shall assist the CxA with documenting PFC information for any energized equipment. EC shall provide appropriate personnel, equipment, and PPE to gather required.

3.7 NON-CONFORMANCE AND COMMISSIONING ISSUES

A. Refer to *Division 01 90 00* for information regarding Non-Conformance and Cx Issues.

3.8 OWNER TRAINING

A. The GC/CM is responsible for execution of Owner Training as outlined in *Division 01 80 00*.

DIVISION 26 09 00 – LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Occupancy sensors.
B. Daylighting controls.

1.02 RELATED REQUIREMENTS

A. *Division 26 05 25* - Hangers and Supports for Electrical Systems
B. *Division 26 05 10* - Boxes for Electrical Systems.
C. *Division 26 05 50* - Identification for Electrical Systems: Identification of products and requirements.
D. *Division 26 05 30* - Wiring Devices: Devices for manual control of lighting, including wall switches and wall dimmers.
   1. Includes finish requirements for wall controls specified in this section.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.
B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
C. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
E. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.
F. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
   3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
   4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
   5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
B. Sequencing:
   1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
C. Shop Drawings:
   1. Occupancy Sensors: Provide lighting plan indicating location, model number, and

orientation of each occupancy sensor and associated system component.
2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.

D. Samples:
1. Upon Request.

E. Field Quality Control Reports.

F. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Operation and Maintenance Data: Include detailed information on device programming and setup.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See *Division 01 60 00* - Product Requirements, for additional provisions.
2. Extra Locking Receptacle-Mounted Outdoor Photo Controls: Five percent of total quantity installed for each type, but not less than two of each type.

I. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.

B. Provide two-year manufacturer warranty for all occupancy sensors.

C. Provide two-year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.

D. Provide two-year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY SENSORS

A. Manufacturers:
1. Lutron Electronics Company, Inc: www.lutron.com/sle.
2. Philips: www.lighting.philips.com
3. Substitutions: See *Division 01 60 00* - Product Requirements.
4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. All Occupancy Sensors:
1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.

2. Sensor Technology:
    a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
    b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
    c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
    d. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
8. Sensitivity: Field adjustable.
9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
10. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
11. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
12. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
13. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
14. Wireless Sensors:
    a. RF Range: 30 feet (9 m) through typical construction materials.
    b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
    c. Power: Battery-operated with minimum ten-year battery life.

C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
    b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
    c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
    d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
    e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
    f. Provide selectable audible alert to notify occupant of impending load turn-off.
    g. Finish: Match finishes specified for wiring devices in *Division 26 27 26*, unless otherwise indicated.

h. Provide vandal resistant lenses for passive infrared (PIR) and dual technology wall switch occupancy sensors where indicated.

2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).
3. Ultrasonic Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 400 square feet (37.2 sq m).
4. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).

D. Wall Dimmer Occupancy Sensors:
1. General Requirements:
a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability, and no leakage current to load in off mode.
b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
e. Provide field adjustable dimming preset for occupied states.
f. Provide fade-to-off operation to notify occupants of impending load turn-off.
g. Finish: Match finishes specified for wiring devices in *Division 26 27 26*, unless otherwise indicated.
2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).

E. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
a. Description: Low profile occupancy sensors designed for ceiling installation.
b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
c. Provide field selectable setting for disabling LED motion detector visual indicator.
d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
e. Finish: White unless otherwise indicated.
2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 square meters) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
3. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
4. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square

feet (111.5 sq m) at a mounting height of 9 feet (2.7 m).

F. Luminaire Mounted Occupancy Sensors: Designed for direct luminaire installation and control, suitable for use with specified luminaires.
   1. Fluorescent High Bay Luminaire Mounted Occupancy Sensors: Passive infrared (PIR) type with a field of view of 360 degrees unless otherwise indicated.
      a. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
      b. Finish: White unless otherwise indicated.
      c. Circular Coverage Sensors: Capable of detecting motion within a distance of 40 feet (12 m) at a mounting height of 20 feet (6.1 m).

G. Power Packs for Low Voltage Occupancy Sensors:
   1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
   2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
   3. Input Supply Voltage: Dual rated for 120/277 V ac.
   4. Load Rating: As required to control the load indicated on drawings.

H. Power Packs for Wireless Occupancy Sensors:
   1. Description: Plenum rated, self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.
   2. Input Supply Voltage: Dual rated for 120/277 V ac.
   3. Load Rating: As required to control the load indicated on drawings.
   4. Rated Life of Relay: One million cycles.

2.03 DAYLIGHTING CONTROLS

A. Manufacturers:
   1. Lutron Electronics Company, Inc: www.lutron.com/sle.
   2. Philips: www.lighting.philips.com
   3. Substitutions: See *Division 01 60 00* - Product Requirements.
   4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

C. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
   1. Sensor Type: Filtered silicon photo diode.
   2. Sensor Range:
      a. Indoor Photo Sensors: 5 to 100 footcandles (53.8 to 1,080 lx).
   3. Finish: White unless otherwise indicated.
   4. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
   5. Wireless Daylighting Control Photo Sensors:
      a. RF Range: 30 feet (9 m) through typical construction materials.
      b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
      c. Power: Battery-operated with minimum ten-year battery life.

D. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.

E. Daylighting Control Switching Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
   1. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
   2. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.

3. Control Capability:
    a. Single Zone Switching Modules: Capable of controlling one programmable channel.

F. Daylighting Control Switching Modules for Wireless Sensors:
1. Description: Plenum rated, self-contained relay compatible with specified wireless photo sensors for switching of line voltage loads in response to changes in measured light levels according to selected settings.
2. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
3. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
4. Control Capability: Capable of controlling one programmable channel.
5. Input Supply Voltage: Dual rated for 120/277 V ac.
6. Load Rating: As required to control the load indicated on drawings.
7. Provide auxiliary contact closure output where indicated.
8. Rated Life of Relay: One million cycles.

G. Daylighting Control Dimming Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors and with specified dimming ballasts, for both continuous dimming of compatible dimming ballasts and switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
2. Load to be turned off when available daylight is sufficient to fully dim the load, after the selected time delay.
3. Control Capability: Capable of controlling up to three separately programmable channels, with up to 50 ballasts per channel.
4. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
5. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.
6. Output Voltage: Compatible with specified dimming ballasts.

H. Daylighting Control Dimming Modules for Wireless Sensors:
1. Description: Plenum rated control unit compatible with specified wireless photo sensors and with specified dimming ballasts, for continuous dimming of compatible dimming ballasts in response to changes in measured light levels according to selected settings.
2. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
3. Load to be turned off when available daylight is sufficient to fully dim the load, after the selected time delay.

I. Power Packs for Low Voltage Daylighting Control Modules:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for switching of line voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
2. Input Supply Voltage: Dual rated for 120/277 V ac.
3. Load Ratings: As required to control the load indicated on drawings.

J. Accessories:
1. Where indicated, provide compatible accessory wall switches for manual override control.
2. Where indicated, provide compatible accessory wireless controls for manual override control.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.
E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.
B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under *Division 26 05 10* as required for installation of lighting control devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switch Occupancy Sensors: 48 inches (1.2 m) above finished floor.
   2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
   3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
B. Install lighting control devices in accordance with manufacturer's instructions.
C. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
D. Install lighting control devices plumb and level, and held securely in place.
E. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 2726.
F. Provide required supports in accordance with *Division 26 05 25*.
G. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
H. Identify lighting control devices in accordance with *Division 26 05 50*.
I. Occupancy Sensor Locations:
   1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.
   2. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
   3. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
   4. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet (1.2 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
J. Daylighting Control Photo Sensor Locations:
   1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize control and avoid conflicts or problems affecting proper detection of light levels.
K. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
L. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.
M. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.04 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.

B. Inspect each lighting control device for damage and defects.
C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
D. Test time switches to verify proper operation.
E. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable.
F. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.
B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
C. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See *Division 01 79 00* - Closeout Submittals, for closeout submittals.
B. See *Division 01 80 00* - Demonstration and Training, for additional requirements.
C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
   4. Location: At project site.

DIVISION 26 09 05 – LIGHTING CONTROLS - LUTRON

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single space wireless lighting control systems and associated components:
   1. Wireless occupancy/vacancy sensors.
   2. Wireless daylight sensors.
   3. Wired load control modules with wireless communication inputs.
   4. Wired wall dimmers and switches with wireless communication inputs.
   5. Wired wallbox occupancy sensors with wireless communication inputs.
   6. Wireless control stations.
   7. Power interfaces.
B. Wireless hub(s) for centralized control, monitoring, and system integration.
C. Software data and analytics dashboard, including server requirements.

1.02 RELATED REQUIREMENTS

A. *Division 26 05 50* - Identification for Electrical Systems: Identification of products and requirements.
B. *Division 26 05 30* - Wiring Devices - Lutron:
   1. Finish requirements for wall controls specified in this section.
   2. Accessory receptacles and wallplates, to match lighting controls specified in this section.
C. *Division 26 50 10* - Luminaires, Ballasts, and Drivers - Lutron.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.
B. ANSI/ESD S20.20 - For the Development of an Electrostatic Discharge Control Program for –

Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices); 2021.

C. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments; 2019.
D. CSA C22.2 No. 223 - Power Supplies with Extra-Low-Voltage Class 2 Outputs; 2015 (Reaffirmed 2020).
E. IEC 60929 - AC and/or DC-Supplied Electronic Control Gear for Tubular Fluorescent Lamps - Performance Requirements; 2011, with Amendment (2015).
F. IEC 61000-4-2 - Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test; 2008.
G. IEEE 1789 - IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers; 2015.
H. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
I. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).
J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
K. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
L. NEMA SSL 7A - Phase-Cut Dimming for Solid State Lighting: Basic Compatibility; 2015 (Reaffirmed 2021).
M. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
O. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
P. UL 508 - Industrial Control Equipment; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
Q. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
R. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.
S. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
T. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.
U. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.
V. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.
W. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; National Electrical Manufacturers Association; 2015.
X. Lighting and Power Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate the placement of wall controls with actual installed door swings.
   3. Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
   4. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.
   5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
B. Pre-Wire Meeting: Include as part of the base bid additional costs for Lighting Control Manufacturer to conduct on-site meeting prior to commencing work. Manufacturer to review with installer:
   1. Low voltage wiring requirements.
   2. Separation of power and low voltage/data wiring.
   3. Wire labeling.

4. Wireless hub locations and installation.
5. Control locations.
6. Load circuit wiring.
7. Network wiring requirements.
8. Connections to other equipment.
9. Installer responsibilities.

C. Sequencing:
1. Do not install sensors and wall controls until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements for submittal procedures.
B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
1. Occupancy/Vacancy Sensors: Include detailed basic motion detection coverage range diagrams.
2. Wall Dimmers: Include derating information for ganged multiple devices.
C. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
D. Project Record Documents: Record actual installed locations and settings for lighting control system components.
E. Operation and Maintenance Data: Include detailed information on lighting control system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
F. Warranty: Submit sample of manufacturer's Warranty or Enhanced Warranty as specified in Part 1 under “WARRANTY”. Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications:
1. Company with not less than ten years of experience manufacturing lighting control products using wireless communication between devices.
2. Registered to ISO 9001, including in-house engineering for product design activities.
3. Provides factory direct technical support hotline available 24 hours per day, 7 days per week.
4. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.
1. Basis of Design System Requirements, Unless Otherwise Indicated:
a. Ambient Temperature:
1) Lighting Control System Components, Except Fluorescent Electronic Dimming Ballasts: Between 32 and 104 degrees Fahrenheit (40 degrees Celsius).
b. Relative Humidity: Less than 90 percent, non-condensing.
c. Protect lighting controls from dust.

1.09 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.
B. Manufacturer's Standard Warranty, Without Manufacturer Full-Scope Start-Up:
1. Manufacturer Lighting Control System Components: One year 100 percent parts coverage, no manufacturer labor coverage. Upgrades to Five years 100 percent parts coverage, no

manufacturer labor coverage with post-commissioning registration of lighting control system with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer: Lutron Electronics Company, Inc; Vive; www.lutron.com.

B. Substitutions:

1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by Architect and Engineer a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
2. For substitutions, Contractor accepts responsibility and associated costs for all required modifications to related equipment and wiring. Provide complete engineered shop drawings (including power wiring) with deviations from the original design highlighted in an alternate color for review and approval by Architect prior to rough-in.

C. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 LIGHTING CONTROLS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) as suitable for the purpose indicated.

B. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, programming, etc. as necessary for a complete operating system that provides the control intent indicated.

C. Design lighting control equipment for 10-year operational life while operating continually at any temperature in an ambient temperature range of 32 degrees Fahrenheit (0 degrees Celsius) to 104 degrees Fahrenheit (40 degrees Celsius) and 90 percent non-condensing relative humidity.

D. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.

E. Power Failure Recovery: When power is interrupted and subsequently restored, lights to automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.

F. Wireless Devices:

1. Wireless device family includes area or fixture level sensors, area or fixture level load controls for dimming or switching, and load controls that can be mounted in a wallbox, on a junction box, or at the fixture.
2. Wireless devices including sensors, load controls, and wireless remotes or wall stations, can be set up using simple button press programming without needing any other equipment (e.g. central hub, processor, computer, or other smart device).
3. Wireless hub adds the ability to set up the system using any smart device with a web browser (e.g. smartphone, tablet, PC, or laptop).
4. System does not require a factory technician to set up or program the system.
5. Capable of diagnosing system communications.
6. Capable of having addresses automatically assigned to them.
7. Receives signals from other wireless devices and provides feedback to user.
8. Capable of determining which devices have been addressed.
9. RF Range: 60 feet (1828.8 cm) line-of-sight or 30 feet (914.4 cm) through typical construction materials between RF transmitting devices and compatible RF receiving devices.
10. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 15, for Class B application.

G. Wireless Network:

1. RF Frequency: 434 MHz; operate in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.
    a. Wireless sensors, wireless wall stations and wireless load control devices do not operate in the noisy 2.4 GHz frequency band where high potential for RF interference exists.
    b. Wireless devices operate in an uncongested frequency band providing reliable

operation.
c. Fixed network architecture ensures all associated lights and load controls respond in a simultaneous and coordinated fashion from a button press, sensor signal, or command from the wireless hub (i.e. no popcorning).
2. Distributed Architecture: Local room devices communicate directly with each other. If the wireless hub is removed or damaged, local control, sensing, and operation continues to function without interruption.
3. Local room devices communicate directly with each other (and not through a central hub or processor) to ensure:
a. Reliability of system performance.
b. Fast response time to events in the space (e.g. button presses or sensor signals).
c. Independent operation in the event of the wireless hub being removed or damaged.

H. Device Finishes:
1. Wall Controls: To be selected by Architect
2. Standard Colors: Comply with NEMA WD1 where applicable.
3. Color Variation in Same Product Family: Maximum delta E of 1, CIE L*a*b color units.
4. Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

I. Interface with building automation system as shown in contract documents.

2.03 WIRELESS SENSORS

A. General Requirements:
1. Operational life of 10 years without the need to replace batteries when installed per manufacturer's instructions.
2. Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.
3. Does not require external power packs, power wiring, or communication wiring.
4. Capable of being placed in test mode to verify correct operation from the face of the unit.

B. Wireless Occupancy/Vacancy Sensors:
1. General Requirements:
a. Provides a clearly visible method of indication to verify that motion is being detected during testing and that the unit is communicating to compatible RF receiving devices.
b. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
c. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
d. Provide optional, readily accessible, user-adjustable controls for timeout, automatic/manual-on, and sensitivity.
e. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 5, 15, and 30 minutes.
f. Capable of turning dimmer's lighting load on to an optional locked preset level selectable by the user. Locked preset range to be selectable on the dimmer from 1 percent to 100 percent.
g. Color: White.
h. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
i. Provide temporary mounting means for drop ceilings to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be design for easy, damage-free removal.
j. Sensor lens to illuminate during test mode when motion is detected to allow installer to place sensor in ideal location and to verify coverage prior to permanent mounting.
k. Ceiling-Mounted Sensors:
1) Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
2) Provide recessed mounting bracket compatible with drywall and compressed fiber

ceilings.

l. Wall-Mounted Sensors: Provide wall or corner mounting brackets compatible with drywall and plaster walls.

2. Wireless Combination Occupancy/Vacancy Sensors:
   a. Ceiling-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), an occupancy sensor with low light feature (automatic-on when less than one footcandle of ambient light available and automatic-off), or a vacancy sensor (manual-on and automatic-off).
   b. Wall-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), or a vacancy sensor (manual-on and automatic-off).
   c. Product(s):
      1) Ceiling-Mounted Occupancy/Vacancy Sensor: Coverage from 324 sq feet (0.34876 sq cm) to 676 sq feet (0.72766 sq cm) depending on ceiling height from 8 to 12 feet (365.76 cm); 360 degree field of view.

C. Wireless Daylight Sensors:
   1. Product: Lutron Radio Powr Savr Series, Model LFR2-DCRB-WH.
   2. Open-loop basis for daylight sensor control scheme.
   3. Stable output over temperature from 32 degrees Fahrenheit (0 degrees Celsius) to 104 degrees Fahrenheit (40 degrees Celsius).
   4. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
   5. Provide linear response from 2 to 150 footcandles.
   6. Color: White.
   7. Mounting:
      a. Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
      b. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
      c. Provide temporary mounting means for drop ceilings to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be design for easy, damage-free removal.

2.04 LOAD CONTROL MODULES

A. Provide wireless load control modules as indicated or as required to control the loads as indicated.

B. Junction Box-Mounted Modules:
   1. Plenum rated.
   2. 0-10 V Dimming Modules:
      a. Product(s):
         1) 8 A dimming module with 0-10V control, without emergency mode.
         2) 8 A dimming module with 0-10V control, with emergency mode.
      b. Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.
      c. Single low voltage dimming module with Class 1 or Class 2 isolated 0-10V output signal conforming to IEC 60929 Annex E.2; source or sink automatically configures.
      d. Selectable minimum light level.
      e. Configurable high- and low-end trim.
      f. Relay: Rated for 0-10 V ballasts, LED drivers, or fixtures that conform with NEMA 410.
      g. Dimming Modules with Emergency Mode:
         1) Operation With Wireless Hub: Upon loss of power, dimming module enters and remains in emergency mode as long as wireless hub is de-energized; upon restoration of power to wireless hub, dimming module returns to normal mode and lights automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
         2) Operation Without Wireless Hub: Upon loss of power, dimming module enters and remains in emergency mode for 90 minutes, during which time local unit buttons and wireless controls are disabled.

3) Used with emergency lighting interface to achieve total system UL 924 Lutron's PowPak® relay module with Softswitch® is a radio frequency (RF) device that uses Lutron patented Softswitch® technology to control up to 16 A of general-purpose load (16 A and 5 A models available) based on input from Pico® wireless controls and Radio Powr Savr™ wireless occupancy/vacancy sensors and wireless daylight sensors. An optional low-voltage dry contact closure output is available to communicate occupancy status to 3rd-party systems such as HVAC controllers. PowPak® modules communicate with compatible Lutron sensors using Clear Connect® RF Technology, which ensures smooth, consistent performance. Lutron's patented Softswitch® circuit eliminates relay arcing at mechanical contacts, extending relay life to an average of 1 million cycles.

3. Relay Modules:
   a. Product(s):
      1) 16 A relay module, without emergency mode, without contact closure output.
      2) 16 A relay module, with emergency mode, without contact closure output.
      3) 16 A relay module, without emergency mode, with contact closure output.
      4) 5 A relay module, without emergency mode, without contact closure output.
      5) 5 A relay module, without emergency mode, with contact closure output.
   b. Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.
   c. Relay:
      1) Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
      2) Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
      3) Fully rated output continuous duty for inductive, capacitive, and resistive loads.
   d. Contact Closure Output:
      1) Single contact closure output with normally open and normally closed dry-maintained contacts suitable for connection to third party equipment (e.g. building management system, HVAC system, etc.).
      2) Contact Ratings: Resistive load; 1 A at 0-24 VDC, 0.5 A at 0-24 VAC.
      3) Controlled by associated occupancy/vacancy sensors and wall controls.
   e. Relay Modules With Emergency Mode:
      1) Operation With Wireless Hub: Upon loss of power, relay module enters and remains in emergency mode as long as wireless hub is de-energized; upon restoration of power to wireless hub, relay module returns to normal mode and lights automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
      2) Operation Without Wireless Hub: Upon loss of power, relay module enters and remains in emergency mode for 90 minutes, during which time local unit buttons and wireless controls are disabled.
      3) Used with emergency lighting interface to achieve total system UL 924 listing.

2.05 WIRED WALLBOX OCCUPANCY SENSORS WITH WIRELESS COMMUNICATION INPUTS

A. 0-10 V Wall Dimmer/Switch Combination Occupancy/Vacancy Sensors with Wireless Communication Inputs:
   1. Communicates via radio frequency with up to ten compatible wireless occupancy/vacancy sensors, ten wireless control stations, and one wireless daylight sensor.
   2. Compatible with sourcing electronic 0-10 V ballasts/drivers, as per IEC 60929 Annex E.2 0-10 V protocol.
   3. Selectable option to enable low light feature (automatic-on when ambient light is below threshold). Ambient light threshold to be selectable as either adaptive utilizing occupant feedback or as fixed (high, medium, low, and minimum presets).
   4. Occupancy/Vacancy Sensors:
      a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.

b. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
c. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
d. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area; adjustable timeout settings (1, 5, 15, or 30 minutes).
e. Adjustable sensitivity (high, medium, low, and minimum presets).
f. Selectable option to inhibit automatic turn-on of lights after manual-off operation while room is occupied for applications such as presentation viewing in conference rooms and classrooms; when room is vacated, returns to normal automatic-on operation after time delay period.
g. Selectable walk-through mode to override selected timeout and automatically turn off lights if no motion is detected within 3 minutes after initial occupancy for applications where space may be briefly occupied.

5. Dimmer Features:
   a. Adjustable high/low end trims.
   b. Selectable dimming curve (linear or switched).
   c. Selectable fade on/fade off times (15, 5, 2.5, or 0.75 sec).
   d. Adjustable auto-on light level (fully adjustable from one to 100 percent).
6. Dimmer Control: Multi-function tap switch with small, raised rocker for dimmer adjustment.
   a. Rocker raises/lowers light level, with new level becoming the current preset level.
   b. Switch single tap raises lights to preset level or fades lights to off.
   c. Switch double tap raises light to full on level.
7. Switch Control: Switch single tap turns lights on/off.
8. Product(s):
   a. Passive Infrared 0-10 V Wall Dimmer Occupancy/Vacancy Sensor: 0-10 V control for 0-10 V fluorescent ballasts/LED drivers (8 A load at 120-277 V, 50 mA max control current); coverage of 900 sq feet (0.96878 sq cm) with mounting height of 4 feet (121.92 cm); 180 degree field of view; multi-location capability using wireless control stations with wallbox mounting adapter.
      1) Sensor dimmer; occupancy/vacancy.
      2) Sensor switch; occupancy/vacancy.

2.06 WIRELESS CONTROL STATIONS

A. Product(s):
   1. 2-Button Control.
      a. Button Marking: As indicated on drawings
   2. 3-Button with Raise/Lower Control.
      a. Button Marking: As indicated on drawings
   3. 4-Button.
      a. Button Marking: As indicated on drawings
   4. Screw Mounting Kit.
   5. Wallbox Adapter.
B. Quantity: As indicated on drawings
C. Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.
D. Does not require external power packs, power or communication wiring.
E. Allows for easy reprogramming without replacing unit.
F. Button Programming:
   1. Single action.
   2. Toggle action.
G. Includes LED to indicate button press or programming mode status.
H. Mounting:
   1. Capable of being mounted with a table stand or directly to a wall under a faceplate.
   2. Faceplates: Provide concealed mounting hardware.

I. Power: Battery-operated with minimum ten-year battery life (3-year battery life for night light models).
J. Finish: As selected by Architect

2.07 WIRELESS HUBS

A. Product(s):
   1. Wireless hub without BACnet.
      a. Flush-mount wireless hub; supports up to 70 total paired devices.
      b. Flush-mount wireless hub; supports up to 700 total paired devices.
      c. Surface-mount wireless hub; supports up to 700 total paired devices.
B. Integrated multicolor LED provides feedback on what mode the hub is in for simple identification and diagnosis.
C. Integrated processor and web server allows hub to set up and operate the system without any external connections to outside processors, servers, or the internet.
D. Utilizes Ethernet connection for:
   1. Networking up to 64 hubs together to create a larger system.
   2. Integration with Building Management System (BMS) via native BACnet; does not require interface (wireless hub with BACnet only).
   3. Remote connectivity capabilities, including maintaining system date/time and receiving periodic firmware updates (requires internet connection).
E. A single hub or network of hubs can operate on either a dedicated lighting control only network or can be integrated with an existing building network as a VLAN.
F. Communicates directly to compatible RF devices through use radio frequency communications link; does not require communication wiring; RF range of 71 feet (2164.08 cm) through walls to cover an area of 15836 sq feet (17.04629 sq cm) (device and hub must be on the same floor).
G. Communicates directly to mobile device (smartphone or tablet) or computer using built-in Wi-Fi, 2.4 GHz 802.11b/g; wireless range of 71 feet (2164.08 cm) through walls (device and hub must be on the same floor).
   1. Does not require external Wi-Fi router for connecting to the hub.
H. Allows for system setup, control, and monitoring from mobile device or computer using web-based software:
   1. Supports paired devices up to maximum number indicated including compatible wireless sensors, wireless control stations, and wireless load devices.
   2. Allows for timeclock scheduling of events, both time of day and astronomic (sunrise and sunset).
      a. Timeclock is integrated into the unit and does not require a constant internet connection.
      b. Retains time and programming information after a power loss.
      c. 365-day schedulable timeclock allows for:
         1) Scheduling of events years in advance.
         2) Setting of recurring events with exceptions on holidays.
      d. Time clock events can be scheduled to:
         1) Send lights to a desired level and select the fade rate desired to reach that level.
         2) Adjust level lights go to when occupied.
         3) Adjust level lights go to when unoccupied.
         4) Enable/disable occupancy.
         5) Adjust timeout of sensors (requires wired fixture sensor or wireless fixture control dongle with integral sensing capabilities).
         6) Control individual devices, areas, or groups of areas. When connected to server, only areas or groups of areas can be controlled with timeclock events.
   3. Allows for control, monitoring, and adjustment from anywhere in the world (wireless hub internet connection required).
   4. Uses RF signal strength detection to find nearby devices for quick association and programming without having to climb ladders.
      a. Association and setup does not require a factory technician to perform.
   5. System using wireless hub(s) can operate with or without connection to the internet.
   6. Supports energy reporting.

a. Reports measured energy data for fixture control modules at accuracy of plus/minus 2 percent or 0.5 W (whichever is higher).
b. Reports calculated energy data for junction box mounted modules at accuracy of 10 percent.

7. Supports automatic demand response for load shedding via:
   a. Local contact closure without need for separate interface.
   b. OpenADR® 2.0b compliant utility command.
   c. BACnet (wireless hub with BACnet only).
8. Support automatic generation of alerts in web-based application for designated events/triggers, including:
   a. Low-battery condition in battery-operated sensors and controls; alert cleared when battery is replaced.
   b. Missing device (e.g., control or sensor); alert cleared when device is detected by system.
9. Wireless hub can be firmware upgraded to provide new software features and system updates.
   a. Firmware update can be done either locally using a wired Ethernet connection or Wi-Fi connection, or remotely if the wireless hub is connected to the internet.

I. Web-Based Application:
1. Accessibility and Platform Support:
   a. Web-based; runs on most HTML5 compatible browsers (including Safari and Chrome).
   b. Supports multiple platforms and devices; runs from a tablet, desktop, laptop, or smartphone.
   c. User interface supports multi-touch gestures such as pinch to zoom, drag to pan, etc.
   d. Utilizes HTTPS (industry-standard certificate-based encryption and authentication for security).
   e. Multi-level Password Protected Access: Individual password protection on both the integrated Wi-Fi network and web-based software.
   f. WPA2 security for Wi-Fi communication with wireless hub.
2. System Navigation and Status Reporting:
   a. Area Tree View: Easy navigation by area name to view status and make programing adjustments through the software.
   b. Area and device names can be changed in real time.
3. Setup app available for iOS and Android that allows for:
   a. Job registration to extend product warranty.
   b. Management of setup for multiple projects in different locations.
   c. Creation of handoff documents that are sent directly to a facility manager via email once setup is complete.
   d. Backup of wireless hub database to cloud for hub replacement.
   e. Access to native help and instructions to assist user with system setup.

J. Scenes:
1. Support programmable scenes to control individual devices, areas, or groups of areas on demand.
2. Scenes may be activated via:
   a. Contact closure input.
   b. API integration.
   c. Manual activation in app.

K. Emergency Mode:
   a. Support emergency mode to, when triggered, send lights to defined levels and lock out controls for load control modules equipped with emergency mode.
2. Emergency mode may be activated via:
   a. Contact closure input.
   b. API integration.
   c. Manual activation in app.

L. Contact Closure Interface: Provide two contact closure inputs; accepts both momentary and maintained contact closures that can be used for automatic demand response.

M. Rated for use in air-handling spaces as defined in UL 2043.
N. Provide Ethernet switch(es) as required for inter-hub network wiring per manufacturer's instructions; do not exceed manufacturer's required maximum wiring segment lengths.
    1. Product(s):
        a. 16 port.
        b. 24 port.
        c. 24 port, 1 multi-mode fiber.
        d. 24 port, 2 multi-mode fiber.
        e. 24 port, 1 single-mode fiber.
        f. 24 port, 2 single-mode fiber.

2.08 SOFTWARE DATA AND ANALYTICS DASHBOARD

A. Control and Monitor Software:
    1. General Requirements:
        a. Web-based; runs on most HTML5 compatible browsers (including Internet Explorer, Chrome, and Safari).
        b. Supports multiple platforms and devices; runs from a tablet, desktop, laptop, or smartphone; optimized for displays of 1024 by 768 pixels or higher.
        c. User interface supports multi-touch gestures such as pinch to zoom, drag to pan, etc.
        d. Utilizes HTTPS (industry-standard certificate-based encryption and authentication for security).
        e. All functionality listed below must be available via a single application.
    2. System Navigation and Status Reporting:
        a. Performed using graphical floor plan view or a generic system layout.
        b. Graphical Floor Plan View: Utilizes customized CAD based drawing of the building. Pan and zoom feature allows for easy navigation; dynamically adjusts the details presented based on zoom level.
    3. Control of Lights:
        a. Control and monitor zone/area lights.
            1) Area lights can be monitored for on/off status from a graphical floor plan or generic system layout.
            2) All lights in an area can be turned on/off (dimmable lights can also be dimmed up/down from current level).
    4. Occupancy:
        a. Area occupancy can be monitored.
            1) Can be monitored graphically if a graphical floor plan has been created.
            2) Can be monitored historically in space utilization reports.
        b. Scheduled events can be created to change occupancy parameters as described under "Scheduling" below.
    5. Load Shedding: View current load shed status (active/inactive) for each wireless hub and enable/disable load shed for the entire building/system.
    6. Scheduling: Schedule time of day and astronomic time clock events to automate functions.
        a. Scheduled events can control the following:
            1) Area light levels for all dimmable lights in an area.
            2) On/off status of all switched lights and contact-closure outputs in an area.
            3) On/off status of all switched receptacles in an area.
        b. Scheduled events can be created to change the following occupancy parameters:
            1) Enable/disable sensors.
            2) Change occupancy mode (auto-on/auto-off versus manual-on/auto-off).
            3) Adjust occupied and/or unoccupied level.
            4) For compatible individual fixture sensors, sensor timeout can be adjusted.
        c. Easily monitor and adjust scheduled events using a weekly calendar view.
    7. Reporting: Provide reporting capability that allows the building manager to gather real-time and historical information about the system as follows:
        a. Energy Reports: Show a comparison of cumulative energy used over a period of time for one or more areas.
        b. Power Reports: Show power usage trend over a period of time for one or more areas.

c. Space Utilization/Occupancy Reports: Show historical occupancy over a period of time for one or more areas using a graphical floor plan, generic system layout, and graphs and charts.

8. Administration:
   a. Users: Allows new user accounts to be created and existing user accounts to be edited.
      1) Supports Active Directory (LDAP) tying user accounts to network accounts.
   b. Area and feature access can be restricted based on login credentials.
   c. Supports up to 20 concurrent users and 10,000 user accounts.
9. Devices/Settings Adjustment:
   a. Users with appropriate permissions can navigate to the wireless hub setup screens in order to view and/or adjust specific settings for areas or devices (including load shed settings, daylighting settings, device associations and programming, occupancy settings, high-end/low-end trim settings, etc).
10. Control and Monitor for Multiple Systems:
    a. Allows user to view aggregate data from multiple connected systems spanning multiple buildings through a single user account:
       1) Space utilization/occupancy.
       2) Energy usage/savings.
    b. Allows user to view details and adjust settings for any connected system; supports system navigation through campuses and buildings using graphical floor plans.

B. Computers:
1. Server:
   a. Suitable for 24 hours per day, 7 days per week programming, monitoring, control, and data logging of digital-network lighting controls.
   b. Suitable to handle client machine requests in multi-computer systems.
   c. Unless otherwise indicated, computer to be provided by others, meeting lighting control system manufacturer's minimum requirements.
   d. Minimum Hardware Requirements:
      1) Processor: Quad Core Intel® Xeon®.
      2) 8 GB Ram.
      3) 250 GB hard drive (40 GB for application and database).
      4) Two 10/100/1000 Ethernet network interfaces - one for communication with lighting management hubs and one for communication with corporate intranet to allow access from system PCs and/or energy saving display terminals. Only one Ethernet network interface is required if all lighting management hubs and client PCs are on the same network.
      5) Monitor with 1280 x 1024 resolution.
      6) 4 USB 2.0 ports.
      7) Dedicated Graphics Card with 256 MB of memory (only required if running client software from the server).
   e. Minimum Software Requirements:
      1) Licensed installation of US English 64-bit Microsoft® Windows® Server 2008 R2, Windows Server 2012 R1, or Windows Server 2012 R2.
      2) Microsoft® Internet Information Services (IIS) 7 or later.
      3) Microsoft® Internet Explorer 9 or later.
      4) Microsoft® .NET Framework 3.5.
      5) Microsoft® .NET Framework 4.5.
2. Computers Provided by Lighting Control System Manufacturer: Computer software to be preinstalled and tested prior to shipping.

2.09 ACCESSORIES

A. Emergency Lighting Interface:
1. Provides total system listing to UL 924 when used with lighting control system.
2. Senses all three phases of building power.
3. If power on any phase fails provides output to send lights controlled to defined levels. Lights to return to their previous intensities when normal power is restored.
4. Accepts contact closure input from fire alarm control panel.

2.10 SOURCE QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Factory Testing:
   1. Perform full-function factory testing on all completed assemblies. Statistical sampling is not acceptable.
   2. Perform full-function factory testing on 100 percent of all ballasts and LED drivers.
   3. Perform factory burn-in of 100 percent of all ballasts at 104 degrees Fahrenheit (40 degrees Celsius).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.
B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive system components.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. System and Network Integration Consultation: Include as part of base bid additional costs for Lighting Control Manufacturer to conduct meeting with facility representative and other related equipment manufacturers to discuss equipment and integration procedures.
   1. Coordinate scheduling of visit with Lighting Control Manufacturer. Manufacturer recommends that this visit be scheduled early in construction phase, after system purchase but prior to system installation.

3.03 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130
B. Install products in accordance with manufacturer's instructions.
C. Sensor Locations:
   1. Sensor locations indicated are diagrammatic. Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage, in accordance with manufacturer's recommendations.
D. LED Light Engine/Array Lead Length: Do not exceed 100 feet (3048 cm).
E. Identify system components in accordance with Section 26 0553.

3.04 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Manufacturer's Full-Scope Start-Up Service is required
C. Manufacturer’s Programming Service:
   1. Product(s):
      a. On-site programming, 8-hour block.
      b. On-site programming, 4-hour block.
      c. Remote programming, 4-hour block.
   2. Furnish unit prices for each available programming time interval.
D. Manufacturer's Full-Scope Start-Up Service: Provide manufacturer's On-Site Full-Scope Start-Up Service
   1. Remote Full-Scope Start-Up Service: When available in accordance with manufacturer's guidelines, provide access to manufacturer's certified remote startup technician to provide instruction and guidance for complete system functional test.
   2. On-Site Full-Scope Start-Up Service: Manufacturer's authorized Service Representative to conduct site visit upon completion of lighting control system installation to perform system startup and verify proper operation:
      a. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS", authorized Service Representative to verify sensor locations, in accordance with layout provided by Lighting Control Manufacturer; Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.
      b. Verify connection of power wiring and load circuits.

c. Verify connection and location of controls.
d. Energize wireless hubs.
e. Associate occupancy/vacancy sensors, daylight sensors, wireless remotes, and wall stations to load control devices.
f. Provide initial rough calibration of sensors; fine-tuning of sensors is responsibility of Contractor unless provided by Lighting Control Manufacturer as part of Sensor Layout and Tuning service where specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS".
g. Program timeclock schedules per approved sequence of operations.
h. Configure load shed parameters per approved sequence of operations.
i. Verify system operation control by control.
j. Obtain sign-off on system functions.
k. Train Owner's representative on system capabilities, operation, and maintenance, as specified in Part 3 under "Closeout Activities".

E. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 COMMISSIONING

A. See *Division 01 90 00* for commissioning requirements.

3.07 CLOSEOUT ACTIVITIES

A. See *Division 01 79 00* - Closeout Submittals, for closeout submittals.
B. See *Division 01 80 00* - Demonstration and Training, for additional requirements.
C. Demonstration:
1. Demonstrate proper operation of lighting control devices to Engineer and correct deficiencies or make adjustments as directed.
2. On-Site Performance-Verification Walkthrough: Include as part of the base bid additional costs for lighting control manufacturer to provide on-site demonstration of system functionality to facility representative.

D. Training:
1. Include services of manufacturer's certified service representative to perform on-site training of Owner's personnel on operation, adjustment, and maintenance of lighting control system as part of on-site system start-up services.
2. Customer-Site Solution Training Visit: Include as part of base bid additional costs for Lighting Control Manufacturer to provide one day of additional on-site system training.

E. On-Site Warranty Audit Visit: Include services of manufacturer to perform on-site verification that system meets manufacturer’s requirements as necessary for validation of specified e 5-year warranty.

3.08 MAINTENANCE

A. See *Division 01 70 00* – Execution and Closeout Requirements, for additional requirements relating to maintenance service.

3.09 PROTECTION

A. Protect installed products from subsequent construction operations.

DIVISION 26 09 10 - LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General purpose dry type transformers.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors required for mounting of transformers.

1.03 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point

dimensions, weight, required clearances, service condition requirements, and installed features.
1. Vibration Isolators: Include attachment method and rated load and deflection.

C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
D. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as routine tests.
E. Field Quality Control Test Reports.
F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
G. Maintenance Data: Include recommended maintenance procedures and intervals.
H. Project Record Documents: Record actual locations of transformers.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.
D. Comply with NEC as applicable to installation and construction of electrical power/distribution transformers.
E. Transformers shall be designed for continuous operation as rated kVA, 24 hours per day, 365 days per year with normal life expectancy as defined by ANSI C57.96.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.06 FIELD CONDITIONS

1.07 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.

1.08 SEISMIC QUALIFICATIONS

A. Provide Seismic tested equipment as follows:
1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the International Building Code with seismic values as determined by the structural calculations.

B. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil/structural engineer in the state of the project. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

C. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualifications shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Siemens Industry, Inc: www.usa.siemens.com.
B. General Electric Company: www.geindustrial.com.
C. Eaton Corporation: www.eaton.com/#sle.
D. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
E. Substitutions: See *Division 01 60 00* - Product Requirements.
F. Source Limitations: Furnish transformers produced by a single manufacturer for all transformers

on this project.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed and labeled by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
   1. Altitude: Less than 3,300 feet (1,000 m).
   2. Ambient Temperature:
      a. Greater than 10 kVA: Not exceeding 104 degrees F (40 degrees C).
      b. Less than 10 kVA: Not exceeding 77 degrees F (25 degrees C).

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

I. Provide system and enclosure grounding at the secondary side of the transformer in accordance with NEC requirements for separately derived systems (See Art. 250-26 of NEC). This must include a grounding conductor from system neutral and enclosure grounding point to building steel (See Section 26 0526 - Grounding and Bonding for Electrical Systems).

J. After wiring systems are connected, adjust transformer tap settings for proper secondary voltage at transformer terminals under normal transformer load conditions.

K. Demonstrate compliance with specifications, including compliance with sound level requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

2.03 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B. Primary Voltage: 480 volts delta, 3 phase or as noted on the drawings.

C. Secondary Voltage: 208Y/120 volts, 3 phase or as noted on the drawings.

D. Insulation System and Allowable Average Winding Temperature Rise:
   1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
   2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

E. Limit terminal compartment temperature to 70 degrees C when transformer is operating continuously at rated load with ambient temperature of 40 degrees C.

F. Provide wiring connectors suitable for 75 degrees C insulated copper wiring.

G. Cushion-mount transformer core and coil assembly for vibration isolation.

H. Electrically ground core and coil assembly to transformer enclosure by means of flexible metal grounding strap.

I. Coil Conductors: Continuous copper windings impregnated with nonhygroscopic, thermosetting varnish with terminations brazed or welded.

J. Winding Taps:
   1. Less than 3 kVA: None.
   2. 3 kVA through 15 kVA: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
   3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5

percent full capacity primary taps below rated voltage.

K. Energy Efficiency: Standard efficiency complying with NEMA TP 1, or as noted on the drawings.
L. Sound Levels: Standard sound levels complying with NEMA ST 20.
M. Mounting Provisions:
    1. Less than 15 kVA: Suitable for wall mounting.
    2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
    3. Larger than 75 kVA: Suitable for floor mounting.
N. Transformer Enclosure: Comply with NEMA ST 20.
    1. Environment Type per NEMA 250.
        a. Indoor clean, dry locations: Type 2.
        b. Outdoor locations: Type 3R.
    2. Construction: Steel.
        a. Less than 15 kVA: Totally enclosed, non-ventilated.
        b. 15 kVA and Larger: Ventilated.
    3. Finish: Manufacturer's standard grey. Apply manufacturer's standard enamel over cleaned and phosphatized steel enclosure.
    4. Provide lifting eyes or brackets.
O. Accessories:
    1. Mounting Brackets: Provide manufacturer's standard brackets.
    2. Weathershield Kits: Provide for ventilated transformers installed outdoors to provide a listed NEMA 250, type 3R assembly.
    3. Lug Kits: Sized as required for termination of conductors.

2.04 SOURCE QUALITY CONTROL

A. Factory test transformers according to NEMA ST 20.
B. Sound Level Tests: Perform factory test designated in NEMA ST 20 as "design" test on each production unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.
C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Install transformers in accordance with NECA 409 and IEEE C57.94.
D. Conduit connections to transformers shall be made through short lengths (not more than 30") of liquid-tight metal conduit.
E. 2 feet (600 mm) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure
F. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
G. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
H. Mount floor-mounted transformers on properly sized 3-inch-high concrete pad constructed in accordance with Section 03 3000.
I. Mount all transformers using vibration isolators suitable for isolating the transformer noise from the building structure.
J. Mount trapeze-mounted transformers as indicated.
K. Provide seismic restraints.
L. Provide grounding and bonding in accordance with *Division 26 05 23*.
M. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

N. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.
O. Where furnished as a separate accessory, install transformer weathershield per manufacturer's instructions.
P. Identify transformers in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Inspect and test in accordance with NETA ATS, except Section 4.
C. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.

3.04 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.
B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from transformer components according to manufacturer's instructions.
B. Repair scratched or marred exterior surfaces to match original factory finish.

DIVISION 26 09 20 - SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.
B. Overcurrent protective devices for switchboards.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Concrete equipment pads.
B. *Division 26 05 23* - Grounding and Bonding for Electrical Systems.
C. *Division 26 05 25* - Hangers and Supports for Electrical Systems.
D. *Division 26 05 50* - Identification for Electrical Systems: Identification of products and requirements.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.
B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.
E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
F. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.
G. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less; 2023.
H. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
K. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
L. UL 891 - Switchboards; Current Edition, Including All Revisions.
M. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance

requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Service Entrance Switchboards:
1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
3. See websites for Utility Company contact information and additional requirements.
4. Obtain Utility Company approval of switchboard prior to fabrication.
5. Preinstallation Meeting: Convene one week prior to commencing work of this section to review requirements with Utility Company representative.
6. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstands ratings, and time-current curves of all equipment and components.
C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and switchboard instrument details; instructions for handling and installation of switchboard.
D. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.
E. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 2 as production (routine) tests.
F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
G. Field Quality Control Test Reports.
H. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.
I. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See *Division 01 60 00* - Product Requirements, for additional provisions.
2. Submit Operation and Maintenance data under provisions of *Division 01 70 00* and *Division 01 90 00*.
3. Enclosure Keys: Two of each different key.
4. Electronic Trip Circuit Breakers: Provide one portable test set.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.
B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed).

Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switchboards:
   1. Eaton Corporation: www.eaton.com/#sle.
   2. General Electric Company: www.geindustrial.com.
   3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
   4. Siemens Industry, Inc: www.usa.siemens.com/#sle.

B. Substitutions: See *Division 01 60 00* - Product Requirements.

C. Source Limitations: Furnish switchboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 SWITCHBOARDS

A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.

D. Front-Connected Switchboards:
   1. Main Device(s): Individually-mounted.
   2. Feeder Devices: Panel/group-mounted.
   3. Arrangement: Front accessible only (not rear accessible), rear aligned.
   4. Gutter Access: Bolted covers.

E. Service Entrance Switchboards:
   1. Listed and labeled as suitable for use as service equipment according to UL 869A.
   2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
   3. Comply with Utility Company requirements for electrical service.

F. Service Conditions:
   1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
      a. Altitude: Less than 6,600 feet (2,000 m).
      b. Ambient Temperature:
         A. Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
         B. Switchboards Containing Fusible Switches: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).

G. Short Circuit Current Rating:
   1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with *Division 26 05 55*.
   2. Minimum Rating: 65,000 rms symmetrical amperes.
   3. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
   4. Label equipment utilizing series ratings as required by NFPA 70.

H. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

I. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the

installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

J. Bussing: Sized in accordance with UL 891 temperature rise requirements.
   1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
   2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   3. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
   4. Phase and Neutral Bus Material: Copper.
   5. Ground Bus Material: Copper.

K. Conductor Terminations: Suitable for use with the conductors to be installed.
   1. Line Conductor Terminations:
      a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Main and Neutral Lug Type: Mechanical.
   2. Load Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Lug Type:
         A. Provide mechanical lugs unless otherwise indicated.
         B. Provide compression lugs where indicated.

L. Enclosures:
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1 or Type 2 (drip-proof).
   2. Finish: Manufacturer's standard unless otherwise indicated.

M. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with *Division 26 40 00*, list switchboards as a complete assembly including surge protective device.

N. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
   1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
   2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
      a. Use zero sequence ground fault detection method unless otherwise indicated.
      b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
      c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.

O. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.

P. Owner Metering:
   1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified.
   2. Measured Parameters:
      a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
      b. Current (Amps): For each phase and neutral.
      c. Frequency (Hz).
      d. Real power (kW): For each phase, 3-phase total.
      e. Reactive power (kVAR): For each phase, 3-phase total.
      f. Apparent power (kVA): For each phase, 3-phase total.
      g. Power factor.
      h. Real energy (kWh).

i. Reactive energy (kVARh).
j. Apparent energy (kVAh).
k. Current demand.
l. Power demand: Real, reactive, and apparent.

3. Meter Accuracy: Plus/minus 1.0 percent.
4. Features:
   a. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
   b. KYZ pulse output.
   c. Adjustable demand interval.
   d. Remote monitoring capability via PC.

Q. Instrument Transformers:
1. Comply with IEEE C57.13.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Circuit Breakers:
1. Interrupting Capacity:
   a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
   b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
2. Molded Case Circuit Breakers:
   a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
      A. Provide thermal magnetic circuit breakers unless otherwise indicated.
      B. Provide electronic trip circuit breakers where indicated.
   b. Minimum Interrupting Capacity:
      A. 35,000 rms symmetrical amperes at 480 VAC.
   c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
      A. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
      B. Provide interchangeable trip units where indicated.
   d. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
      A. Provide the following field-adjustable trip response settings:
         1. Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
         2. Long time delay.
         3. Short time pickup and delay.
         4. Instantaneous pickup.
         5. Ground fault pickup and delay where ground fault protection is indicated.
      B. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
      C. Provide communication capability where indicated: Compatible with system indicated.

e. Provide the following circuit breaker types where indicated:
   A. 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
   B. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
f. Provide the following features and accessories where indicated or where required to complete installation:
   A. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
   B. Pad-Lock Provision: For locking circuit breaker handle in OFF position.
   C. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
   D. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
   E. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

3. Insulated Case Circuit Breakers:
   a. Description: Quick-make, quick-break, trip-free circuit breakers with two-step stored energy closing mechanism; standard 80 percent rated unless otherwise indicated; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
   b. Operation:
      A. Provide manually operated circuit breakers unless otherwise indicated.
      B. Provide electrically operated circuit breakers where indicated.
      C. Pad-Lock Provision: For preventing circuit breaker closing operation.
   c. Construction:
      A. Provide fixed-mount circuit breakers unless otherwise indicated.
      B. Provide drawout circuit breakers where indicated.
   d. Minimum Interrupting Capacity:
      A. 65,000 rms symmetrical amperes at 480 VAC.
   e. Trip Units: Solid state, microprocessor-based, true rms sensing.
      A. Provide the following field-adjustable trip response settings:
         1. Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
         2. Long time delay.
         3. Short time pickup and delay.
         4. Instantaneous pickup.
         5. Ground fault pickup and delay where ground fault protection is indicated.
      B. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
      C. Provide communication capability where indicated: Compatible with system indicated.
   f. Provide the following circuit breaker types where indicated:
      A. 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
      B. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
   g. Provide the following features and accessories where indicated or where required to complete installation:
      A. Shunt Trip: Provide coil voltage as required for connection to indicated trip

actuator.

B. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
C. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
D. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
E. Truck-Operated Cell Switch: For indicating circuit breaker racking position.

2.04 SOURCE QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
   1. Dielectric tests.
   2. Mechanical operation tests.
   3. Grounding of instrument transformer cases test.
   4. Electrical operation and control wiring tests, including polarity and sequence tests.
   5. Ground-fault sensing equipment test.

2.05 ALTERNATIVE SYSTEM

A. Switchboards combined with integrated power distribution system containing switchboard, panelboards, transformers, transient voltage surge suppression devices, and other electrical equipment will be acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the shop drawings.
B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive switchboards. Provide concrete housekeeping pad under the provisions of *Division 03 30 00*.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.
C. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
D. Arrange equipment to provide required clearances and maintenance access, including accommodation for any drawout devices.
E. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch (10 mm) between switchboard and wall.
F. Provide required support and attachment in accordance with Section 26 0529.
G. Install switchboards plumb and level.
H. Unless otherwise indicated, mount switchboards on properly sized 4 inches (100 mm) high concrete pad constructed in accordance with Section 03 3000.
I. Provide grounding and bonding in accordance with Section 26 0526.
J. Install all field-installed devices, components, and accessories.
K. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
L. Set field-adjustable circuit breaker tripping function settings as indicated.
M. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 26 0573.
N. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
O. Provide filler plates to cover unused spaces in switchboards.
P. Identify switchboards in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Inspect completed installation for physical damage, proper alignment, anchorage and grounding.
C. Check tightness of accessible bolted bus joints using a calibrated torque wrench. Tightness shall

be in accordance with manufacturer's recommended values.

D. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.
E. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
F. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.
G. Inspect and test in accordance with NETA ATS, except Section 4.
H. Perform inspections and tests listed in NETA ATS, Section 7.1.
I. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 100 amperes. Tests listed as optional are not required.
    1. Perform insulation-resistance tests on all control wiring with respect to ground. Test voltage shall be 500 volts, and minimum acceptable value for insulation resistance is 2 megohms.
    2. Test functions of the trip unit by means of secondary injection.
J. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
    1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
K. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
L. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstands tests on primary windings with secondary windings connected to ground listed as optional are not required.
M. Test shunt trips to verify proper operation.
N. Correct deficiencies and replace damaged or defective switchboards or associated components.
O. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
B. Adjust alignment of switchboard covers and doors.

3.05 CLEANING

A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.
B. Repair scratched or marred surfaces to match original factory finish.

3.06 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
    1. The Contractor shall perform the Functional Performance Testing, and the Commissioning Authority shall witness and document the test.
    2. Refer to *Division 01 90 00* - General Commissioning Requirements, for functional performance tests and commissioning requirements.
B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Perform the functional performance testing of Switchboards as part of the electrical system Functional Performance testing.

3.07 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
    1. Provide competent, factory authorized personnel to provide instruction to MP&O personnel concerning the location, operation, and troubleshooting of the installed systems.
    2. Schedule the instructions in coordination with the Owner's Representative after submission and approval of formal training plans.
    3. Refer to *Division 01 90 00* - General Commissioning Requirements, for further contractor training requirements.
B. Provide demonstration and training for all types of Switchboards installed in this project.

3.08 CLOSEOUT ACTIVITIES

A. See *Division 01 79 00* - Closeout Submittals, for closeout submittals.
B. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchboard and associated devices.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Manufacturer's authorized representative.
   4. Location: At project site.

3.09 PROTECTION

A. Protect installed switchboards from subsequent construction operations.

DIVISION 26 10 10 - ENGINE GENERATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged engine generator system and associated components and accessories:
   1. Engine and engine accessory equipment.
   2. Alternator (generator).
   3. Generator set control system.
   4. Generator set enclosure.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Concrete equipment pads.
B. *Division 26 05 23* - Grounding and Bonding for Electrical Systems.
C. *Division 26 05 25* - Hangers and Supports for Electrical Systems.
D. *Division 26 05 50* - Identification for Electrical Systems: Identification of products and requirements.
E. *Division 26 10 20* - Transfer Switches.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
B. NECA/EGSA 404 - Standard for Installing Generator Sets; 2014.
C. NEMA MG 1 - Motors and Generators; 2014.
D. NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.
E. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.
F. UL 2085 - Protected Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.
G. UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.
H. CSA 282.
I. CSA 100.
J. EN61000-6.
K. EN55011.
L. FCC Part 15, Subpart B.
M. ISO8528.
N. IEC61000.
O. UL 508.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
      a. Transfer Switches: See *Division 26 36 00*.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
   3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.

5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week before starting work of this section; require attendance of all affected installers. Provide documentation of attendance upon request.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
   1. Include generator set sound level test data.
   2. Include characteristic trip curves for overcurrent protective devices upon request.
   3. Include alternator thermal damage curve upon request.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

D. Derating Calculations: Indicate ratings adjusted for applicable service conditions.

E. Fuel Storage Tank Calculations: Indicate maximum running time for generator set configuration provided.

F. Specimen Warranty: Submit sample of manufacturer's warranty.

G. Evidence of qualifications for installer.

H. Evidence of qualifications for maintenance contractor (if different entity from installer).

I. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

J. Manufacturer's factory emissions certification.

K. Manufacturer's certification that products meet or exceed specified requirements.

L. Source quality control test reports.

M. Provide NFPA 110 required documentation from manufacturer, including but not limited to:
   1. Certified prototype tests.
   2. Torsional vibration compatibility certification.
   3. NFPA 110 compliance certification.
   4. Certified rated load test at rated power factor.

N. Manufacturer’s detailed field testing procedures.

O. Field quality control test reports.

P. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
   1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

Q. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

R. Maintenance contracts.

S. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

T. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Fuses: One of each type and size.
   3. Extra Filter Elements: One of each type, including fuel, oil and air.

U. Engine-generator submittals shall include the following information:
   1. Factory published specification sheet.
   2. Manufacturer's catalog cut sheets of all auxiliary components such as battery charger, control panel, enclosure, etc.
   3. Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories.
   4. Weights of all equipment.

5. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.
6. Interconnect wiring diagram of complete emergency system, including generator, switchgear, day tank, remote pumps, battery charger, control panel, and remote alarm indications.
7. Engine mechanical data, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, fuel consumption, etc.
8. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
9. Generator resistances, reactances and time constants.
10. Generator locked rotor motor starting curves.
11. Manufacturer's documentation showing maximum expected transient voltage and frequency dips, and recovery time during operation of the generator set at the specified site conditions with the specified loads.
12. Manufacturer's and dealer's written warranty.
13. Prototype test documents are acceptable except that transient voltage, frequency dips, and recovery time during operation shall be for the furnished generator with load bank at least 95% or rating.

1.06 SUBSTITUTION

A. Proposed deviations from the specifications shall be treated as follows:
   1. Substitution Responsibility
      a. The equipment sizing, spacing, amounts, electrical wiring, ventilation equipment, fuel, and exhaust components have all been sized and designed around Generac supplied equipment as a Basis of Design. Equipment manufactured by KOHLER, CATERPILLAR, CUMMINS, or Architect/Engineer Approved equal will be considered providing the deviations from the listed specification are listed and included with the bidding documents. Deviations will not be permitted to environmental and seismic requirements. Should any substitutions be made, the Contractor shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs, which may result from such substitutions.

1.07 QUALITY ASSURANCE

A. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.
   1. Authorized service facilities located within 200 miles (320 km) of project site.
C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years' documented experience with engine generator systems of similar size, type, and complexity; manufacturer's authorized installer.
D. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
   1. Contract maintenance office located within 200 miles (320 km) of project site.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.
B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.
B. Provide minimum two-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

C. Two Year Standby (ISO 8528-1: ESP) Generator Set Warranty
   1. The manufacturer's standard warranty shall in no event be for a period of less than two (2) years from date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall be limited to 500 hours annually for the system warranty by both the manufacturer and servicing distributor. Submittals received without written warranties as specified will be rejected in their entirety.

1.11 WORK INCLUDED

A. Installation
   1. The work includes supplying and installing a complete integrated generator system. The system consists of a diesel generator set with related component accessories and automatic transfer switches specified under this section or a separate section.
B. System Test
   1. A complete system load test shall be performed after all equipment is installed. Guidelines in the Start-up Section.
C. The generator set must be pre-certified to meet EPA federal emission requirements for stationary standby. Documentation of EPA certification for the specific generator provided shall be submitted. On-site emission testing & certification will not be acceptable for standby applications.
D. The generator manufacturer shall provide filled out draft Tennessee Department of Environment and Conservation (TDEC) permit application forms for Owner signature as follows: APC 100 Location, Construction and Operating information; APC-102 Fuel Burning Source Description; APC-101 Emission Point Description. Respond and comply with requirements of the applications that impact the equipment.

1.12 SYSTEM RESPONSIBILITY

A. Generator Set Distributor
   1. The completed engine generator set shall be supplied by the Manufacturer's authorized distributor only.
B. Requirements, Codes and Regulations
   1. All equipment shall be new, of current production. There shall be one source responsibility for warranty; parts and service through a local representative with factory trained service personnel.

1.13 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
D. Provide Seismic qualified equipment as follows:
   1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the International Building Code (IBC) with Seismic values as determined by structural sheet S0.1.
   2. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualifications shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Genset Requirements
   1. The generator set shall be Standby Duty rated at running kw standby, RPM, volts, 3 phase, 4 wire reconnectable, including radiator fan and all parasitic loads. Generator set shall be sized to operate at the specified load at a maximum ambient of 95°F (35.0°C) and altitude of 500.0 feet (152.4 m).
B. All materials and parts comprising the unit shall be new and unused.

C. Engine
   1. The engine shall be gaseous fueled, four (4) cycle, water-cooled, while operating with nominal speed not exceeding 1800 RPM.
   2. Engine Governing
      a. The engine will be equipped with an isochronous electronic governor to maintain +/- 6 RPM steady state frequency variation from steady state no load to steady state full load.

2.02 MANUFACTURERS

A. Packaged Engine Generator Set - Basis of Design: Generac Power Systems.
B. Packaged Engine Generator Set- Other Acceptable Manufacturers:
   1. Caterpillar Inc: www.cat.com/#sle.
   2. Cummins Power Generation, Inc.
   3. Kohler Co: www.kohlerpower.com/#sle.
C. Substitutions: See *Division 01 60 00* - Product Requirements.
D. Source Limitations: Furnish engine generator sets and associated components and accessories produced by a single manufacturer and obtained from a single supplier.

2.03 PACKAGED ENGINE GENERATOR SYSTEM

A. Packaged Engine Generator Set:
   1. Type: Gaseous (spark ignition).
   2. Power Rating: 175kW, standby.
   3. Voltage: As indicated on drawings.
   4. Main Line Circuit Breaker: quantity as indicated on the drawings.
      a. Type: Electronic trip with long time and short time delay and instantaneous pickup.
      b. Trip Rating: Select according to generator set rating.
      c. Features:
         1) Auxiliary contacts.
B. Generator Set General Requirements:
   1. Prototype tested in accordance with NFPA 110 for Level 1 systems.
   2. Factory-assembled, with components mounted on suitable base.
   3. List and label engine generator assembly as complying with UL 2200.
   4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.
   5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.
   6. Main Line Circuit Breakers: Provide factory-installed line side connections with suitable lugs for load side connections.
C. Starting and Load Acceptance Requirements:
   1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
   2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.
   3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 30 seconds (NFPA 110, Type 30).
   4. Maximum Load Step: Supports 100 percent of rated load in one step.
   5. Motor Starter Capability: Sustained voltage dip data is not acceptable. Provide locked rotor motor starting capability of KVA at 1.75 x rated at 30% instantaneous voltage dips as defined per NEMA MG 1.
D. Exhaust Emissions Requirements:
   1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
   2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.

2.04 ENGINE AND ENGINE ACCESSORY EQUIPMENT

A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.

B. Engine Fuel System - Gaseous (Spark Ignition):
   1. Fuel Source: Natural gas.
   2. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
   3. Provide components/features indicated and as necessary for operation and/or required by applicable codes, including but not limited to:
      a. Carburetor.
      b. Gas pressure regulators.
      c. Fuel shutoff control valves.
      d. Low gas pressure switches.

C. Engine Starting System:
   1. System Type: Electric, with DC solenoid-activated starting motor(s).
   2. Battery(s):
      a. Battery Type: Lead-acid.
      b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through three complete periods of cranking limiter time-outs without recharging.
      c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
   3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
   4. Battery Charger:
      a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
      b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
      c. Recognized as complying with UL 1236.
      d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
      e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
      f. Provide alarm output contacts as necessary for alarm indications.
   5. Battery Heater: Provide thermostatically controlled battery heater to improve starting under cold ambient conditions.

D. Engine Speed Control System (Governor):
   1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
   2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.

E. Engine Lubrication System:
   - System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.

F. Engine Cooling System:
   - System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
   - Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
   - Ducted Radiators: Where ducted radiator air discharge is to be field-installed, provide suitable radiator duct flange/adapter.
   - Coolant Heater: Provide thermostatically controlled coolant heater to improve starting under

cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

G. Engine Air Intake and Exhaust System:
   - Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
   - Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.
   - Exhaust Silencer: Provide critical grade or better exhaust silencer with sound attenuation not less than basis of design; select according to manufacturer's recommendations to meet sound performance requirements, where specified.

2.05 ALTERNATOR (GENERATOR)

A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 1; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.

B. Exciter:
   1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
   2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
   3. The automatic voltage regulator (AVR) shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be a totally solid state design, which includes electronic voltage buildup, volts per Hertz regulation, over-excitation protection, shall limit voltage overshoot on startup, and shall be environmentally sealed.

C. Temperature Rise: Comply with UL 2200.

D. Insulation System: NEMA MG 1, Class H; suitable for alternator temperature rise.

E. Enclosure: NEMA MG 1, drip-proof.

F. Total Harmonic Distortion: Not greater than five percent.

2.06 GENERATOR SET CONTROL SYSTEM

A. Provide a fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. The control shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via SAE J1939.

B. Environmental
   1. The generator set control shall be tested and certified to the following environmental conditions.
      - -40°C to +70°C Operating Range.
      - 95% humidity non-condensing, 30°C to 60°C.
      - IP22 protection for rear of controller; IP55 when installed in control panel.
      - 5% salt spray, 48 hours, +38°C, 36.8V system voltage.
      - Sinusoidal vibration 4.3G's RMS, 24-1000Hz.
      - Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2).
      - Shock: withstand 15G.

C. Functional Requirements
   1. The following functionality shall be integral to the control panel.
      - The control shall include a 33 x 132 pixel, 24mm x 95mm, positive image, transflective LCD display with text based alarm/event descriptions.
      - Audible horn for alarm and shutdown with horn silence switch.
      - Standard ISO labeling.
      - Multiple language capability.
      - Remote start/stop control.
      - Local run/off/auto control integral to system microprocessor.
      - Cooldown timer.
      - Speed adjust.
      - Lamp test.
      - Push button emergency stop button.

- Password protected system programming.

D. Control Panel:
   1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
   2. Generator Set Control Functions:
      - Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
      - Manual Mode: Initiates generator set start/shutdown upon direction from operator.
      - Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
      - Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
      - Cycle Cranking: Programmable crank time, rest time, and number of cycles.
      - Time Delay: Programmable for shutdown (engine cooldown).
      - Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
      - All read-outs to be in English units.
   3. Generator Set Status Indications:
      - Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
      - Current (Amps): For each phase.
      - Frequency (Hz).
      - Real power (W/kW).
      - Reactive power (VAR/kVAR).
      - Apparent power (VA/kVA).
      - Power factor.
      - Duty Level: Actual load as percentage of rated power.
      - Engine speed (RPM).
      - Battery voltage (Volts DC).
      - Engine oil pressure.
      - Engine coolant temperature.
      - Engine run time.
      - Generator powering load (position signal from transfer switch).
      - Total kW-hr.
      - Total kVAR-hr.
      - %kW.
      - %kVA.
      - %kVAR
   4. Generator Set Protection and Warning/Shutdown Indications: The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that are stored by the control panel for first and last occurance:
      - Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
      - Overcrank (shutdown).
      - Low coolant temperature (warning).
      - High coolant temperature (warning).
      - High coolant temperature (shutdown).
      - Low oil pressure (warning).
      - Low oil pressure (shutdown).
      - Overspeed (shutdown).
      - Low fuel level (warning).
      - Low coolant level (warning/shutdown).
      - Generator control not in automatic mode (warning).
      - High battery voltage (warning).
      - Low cranking voltage (warning).
      - Low battery voltage (warning).
      - Battery charger failure (warning).
      - Control switch not in auto position alarm.
      - In addition to NFPA 110 requirements, provide the following protections/indications:

- High AC voltage (shutdown).
- Low AC voltage (shutdown).
- High frequency (shutdown).
- Low frequency (shutdown).
- Overcurrent (shutdown).
- Fuel tank leak (warning), where applicable.
- Provide contacts for local and remote common alarm.
- Provide lamp test function that illuminates all indicator lamps.

5. Other Control Panel Features:
   - Event log.
   - Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
   - Remote monitoring capability via PC.

E. Remote Annunciator:
1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.
   - The annunciator shall provide remote annunciation of all points stated below and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.
   - Ability to be located up to 800 feet from the generator set.
2. Generator Set Status Indications:
   - Generator powering load (via position signal from transfer switch).
   - Communication functional.
3. Generator Set Warning/Shutdown Indications:
   - Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following indications:
     - Overcrank (shutdown).
     - Low coolant temperature (warning).
     - High coolant temperature (warning).
     - High coolant temperature (shutdown).
     - Low oil pressure (warning).
     - Low oil pressure (shutdown).
     - Overspeed (shutdown).
     - Low fuel level (warning).
     - Low coolant level (warning/shutdown).
     - Generator control not in automatic mode (warning).
     - High battery voltage (warning).
     - Low cranking voltage (warning).
     - Low battery voltage (warning).
     - Battery charger failure (warning).
     - Provide audible alarm with silence function.
     - Provide lamp test function that illuminates all indicator lamps.

F. Other Control Panel Features
1. Inputs and Outputs
   - Programmable Digital Inputs
   - The Controller shall include the ability to accept eight (8) total with six (6) programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.
   - Programmable Relay Outputs
   - The control shall include the ability to operate eight (8) total with six (6) programmable relay output signals, integral to the controller. The output relays shall be rated for 2A @ 30VDC and consist of six (6) Form A (Normally Open) contacts and two (2) Form C (Normally Open & Normally Closed) contacts.
   - Programmable Discrete Outputs

- The control shall include the ability to operate one (1) discrete output, integral to the controller, which is capable of sinking up to 300mA.

G. Maintenance
1. All engine, voltage regulator, control panel and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control:
   - Engine running hours display.
   - Service maintenance interval (running hours or calendar days).
   - Engine crank attempt counter.
   - Engine successful starts counter.
   - 20 events are stored in control panel memory.
   - Programmable cycle timer that starts and runs the generator for a predetermined time. The timer shall use 14 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:
   - Day of week.
   - Time of day to start.
   - Duration of cycle.

2.07 GENERATOR SET ENCLOSURE

A. No Enclosure, Open type genset.

2.08 SOURCE QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.

B. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

C. Generator Set production testing to include, at a minimum:
1. Operation at rated load and rated power factor.
2. Single step load pick-up.
3. Transient and steady state voltage and frequency performance.
4. Operation of safety shutdowns.

2.09 CIRCUIT BREAKER

A. Circuit Breaker Specifications
1. Provide generator mounted 100% circuit breaker, molded case, Quantity per plans stated amp trip, 3 pole, NEMA 1/IP22. Breaker shall utilize a solid state trip unit. The breaker shall be UL/CSA Listed and connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.

2.10 COOLING SYSTEM

A. The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 110° F ambient air entering the room or enclosure (If an enclosure is specified). The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

2.11 EXHAUST SYSTEM

A. Silencer
1. A critical grade silencer, companion flanges, and flexible stainless steel exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation. Mounting shall be provided by the contractor. The silencer shall be mounted so that its weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the engine manufacturer. Exposed parts shall be protected by high temperature rated finishes to prevent weather corrosion. Provide exhaust condensate trap and drain to trap condensation and prevent condensation from entering the engine.

2.12 STARTING SYSTEM

A. Starting Motor
   1. A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.

B. Jacket Water Heater
   1. Jacket water heater shall be provided and shall be sized to insure that genset will start within the specified time period and ambient conditions.

C. Batteries
   1. Batteries - A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system.

D. Battery Charger
   1. Battery Charger - A current limiting battery charger shall be furnished to automatically recharge batteries. The charger shall be dual charge rate with automatic switching to the boost rate when required. The battery charger shall be mounted on the genset package or inside the genset enclosure/room.

E. Generating Exercise System
   1. Provide 7-day exercising timer system to operate through the ATS to start the generator, run for 1/2 hour under load (time agreement by Owner). Retransfer load and cool down the generator upon completion and shutdown.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.
C. Verify that rough-ins for field connections are in the proper locations.
D. Verify that mounting surfaces are ready to receive equipment.
E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.
D. Arrange equipment to provide minimum clearances and required maintenance access.
E. Unless otherwise indicated, mount generator set on properly sized, minimum 6 inch (150 mm) high concrete pad constructed in accordance with *Division 03 30 00*.
F. Provide required support and attachment in accordance with *Division 26 05 25*.
G. Use manufacturer's recommended oil and coolant, suitable for the worst-case ambient temperatures.
H. Provide duct for cooling air intake/exhaust
I. Provide engine exhaust piping where not factory installed.
   1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.
   2. Do not exceed manufacturer's maximum back pressure requirements.
J. Install exhaust silencer where not factory installed.
K. Provide grounding and bonding in accordance with *Division 26 05 23*.
L. Identify system wiring and components in accordance with *Division 26 05 50*.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.
B. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
C. Notify Owner and Architect/Engineer at least two weeks prior to scheduled inspections and tests.
D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
E. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.

F. Preliminary inspection and testing to include, at a minimum:
    1. Inspect each system component for damage and defects.
    2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
    3. Check for proper oil and coolant levels.
G. Prepare and start system in accordance with manufacturer's instructions.
H. Perform acceptance test in accordance with NFPA 110.
I. Inspection and testing to include, at a minimum:
    1. Verify compliance with starting and load acceptance requirements.
    2. Verify voltage and frequency; make required adjustments as necessary.
    3. Verify phase sequence.
    4. Verify control system operation, including safety shutdowns.
    5. Verify operation of auxiliary equipment and accessories (e.g. battery charger, heaters, etc.).
    6. Perform load tests in accordance with NFPA 110 (1.5 hour building load test followed by 2 hour full load test). Perform a 4 hour load bank test at a 1.0 PF at full nameplate rating. Loadbank, cables and other equipment required for this test to be supplied by the genset supplier.
    7. Record transfer times for switches, crank and starting times, voltage and current at generator and at each transfer switch load side. Return normal power, record transfer times and generator cool down sequence.
J. Provide field emissions testing where necessary for certification.
K. Sound Level Tests: Measure sound levels for compliance with specified requirements. Identify and report ambient noise conditions.
L. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
M. Submit detailed reports indicating inspection and testing results and corrective actions taken.
N. Provide a fresh change of coolant, lubricant oils, and fluids after tests, refill fuel tank and verify battery charge completion. Document to Owner's Representative for installation acceptance.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

A. See *Division 01 79 00* - Closeout Submittals, for closeout submittals.
B. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
C. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
    1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
    2. Provide minimum of four hours of training.
    3. Instructor: Manufacturer's authorized representative.
    4. Location: At project site.
D. After successful acceptance test and just prior to Substantial Completion, replace air, oil, and fuel filters.

3.06 PROTECTION

A. Protect installed engine generator system from subsequent construction operations.

3.07 OPERATION AND MAINTENANCE MANUALS

A. Provide three (3) sets of operation and maintenance manuals covering the generator, switchgear, and auxiliary components. Include final as-built wiring interconnect diagrams and recommended preventative maintenance schedules.
B. Provide sequence of operation for the generator and transfer switch system detailing the operation under power failure and operation for system exercising mode.

3.08 TRAINING

A. On-Site Training
    1. Provide on-site training to instruct the owner's personnel in the proper operation and maintenance of the equipment. Review operation and maintenance manuals, parts manuals, and emergency service procedures.

2. Provide video recording of on-site training to Owner's Representative with copies of instructional aids and list of instruments used for instruction.

3.09 SERVICE

A. Warranty and Supplemental Service.
   1. Manufacturer's warranty on the system shall be supplemented as follows to apply over five years after installation acceptance.
   2. Annual operating test under load shall be conducted by the responsible generator distributor.
   3. System maintenance on annual basis shall check and change all fluids in the engine including lubricant and coolant change out.
   4. Fuel shall be tested for moisture and degraded condition. During any annual maintenance where either of the above is noted it shall be changed. Complete change shall be accomplished a minimum of two times, one during the fifth year.
   5. Gaskets, hoses, and batteries shall be changed out during the fifth year.

3.10 MAINTENANCE

A. See *Division 01 70 00* - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
   Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of engine generator system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.

B. Conduct site visit at least once every three months to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.

C. Provide trouble call-back service upon notification by Owner:
   1. Provide on-site response within 4 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
   3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

D. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

DIVISION 26 10 20 - TRANSFER SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Transfer switches for low-voltage (600 V and less) applications and associated accessories:
   1. Automatic transfer switches.
   2. Includes service entrance rated transfer switches.
   3. Remote annunciators.

1.02 RELATED DOCUMENTS

A. This section is a Division 26 Basic Materials and Methods section and is part of each Division 26 section making reference to automatic transfer switches specified herein.

1.03 SCOPE

A. Furnish and install automatic transfer switches (ATS) with number of poles, amperage, voltage, and withstand current ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch unit and a microprocessor controller, interconnected to provide complete automatic operation. All transfer switches and control panels shall be the product of the same manufacturer.

1.04 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Concrete equipment pads.
B. *Division 14 24 00* - Passenger Elevators: For interface with transfer switch.
C. *Division 26 05 23* - Grounding and Bonding for Electrical Systems.
D. *Division 26 05 25* - Hangers and Supports for Electrical Systems.

E. *Division 26 05 50* - Identification for Electrical Systems: Identification of products and requirements.
F. *Division 26 05 55* - Power System Studies: Additional criteria for the selection of equipment specified in this section.
G. *Division 26 10 10* - Engine Generators: For interface with transfer switches.
   1. Includes code requirements applicable to work of this section.
   2. Includes additional testing requirements.
   3. Includes related demonstration and training requirements.

1.05 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
C. NEMA ICS 10 Part 1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment; 2020.
D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F. NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.
G. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
H. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.
I. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems.
J. International Standards Organization ISO 9001.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
      a. Engine Generators: See *Division 26 10 10*.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
   5. Closed Transition Transfer Switches:
      a. Coordinate source interconnection requirements with Utility Company.
      b. Where applicable, coordinate the work to provide engine generators with isochronous governors suitable for closed transition transfer.
      c. Coordinate the work to provide shunt trip breakers necessary for protection from source interconnection for longer than specified maximum interconnection time.
      d. Preinstallation Meeting: Convene one week prior to commencing work of this section to review interconnection requirements and details with Utility Company representative.
      e. Arrange for inspections necessary to obtain Utility Company approval of installation.
   6. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
B. Preinstallation Meeting: Convene one week before starting work of this section; require attendance of all affected installers.
C. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

1.07 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.
   1. Where applicable, include characteristic trip curves for overcurrent protective devices upon request.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
D. Specimen Warranty: Submit sample of manufacturer's warranty.
E. Evidence of qualifications for installer.
F. Evidence of qualifications for maintenance contractor (if different entity from installer).
G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
H. Manufacturer's certification that products meet or exceed specified requirements.
I. Source quality control test reports.
J. Manufacturer's detailed field testing procedures.
K. Field quality control test reports.
L. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
    1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
M. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.
N. Maintenance contracts.
O. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.
P. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.

1.08 QUALITY ASSURANCE

A. Comply with the following:
    1. NFPA 70 (National Electrical Code).
    2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for Level 2 system.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
    1. Authorized service facilities located within 200 miles (320 km) of project site.
D. Installer Qualifications: Company with minimum three years documented experience with power transfer systems of similar size, type, and complexity; manufacturer's authorized installer.
E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
    1. Contract maintenance office located within 200 miles (320 km) of project site.
F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.
B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.10 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.11 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.
B. Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

1.12 QUALIFICATIONS

A. Provide Seismic tested equipment as follows:
   1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the International Building Code (IBC) with seismic values as determined by structural sheet S0.1.

B. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
   1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil/structural engineer in the state of the project. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
   2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

C. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Transfer Switches - Basis of Design: power Generac: www.generac.com

B. Transfer Switches- Other Acceptable Manufacturers:
   1. ASCO Power Technologies, a brand of Emerson Network Power: www.emersonnetworkpower.com.
   2. Cummins Power Systems: www.powersystems.cummins.com.
   3. Eaton Corporation: www.eaton.com/#sle.
   4. General Electric Company: www.geindustrial.com.
   5. Kohler Company: www.kohlerpower.com .
   6. Architect/Engineer Approved Equal.

C. Substitutions: See *Division 01 60 00* - Product Requirements.

D. Products other than basis of design are subject to compliance with specified requirements. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

E. Source Limitations: Furnish transfer switches and accessories produced by a single manufacturer and obtained from a single supplier.

2.02 TRANSFER SWITCHES

A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Applications:
   1. Utilize open transition transfer unless otherwise indicated or required.
   2. Neutral Switching (Three Phase, Four Wire Systems):
      a. Unless otherwise indicated or required, provide neutral switching:
         1) For systems with ground fault protection.
         2) Where the alternate/emergency source is a separately derived system.
   3. Provide signal before transfer contacts for transfer switches serving elevators.

D. Construction Type: Per Basis of Design.

E. Automatic Transfer Switch:
   1. Transfer Switch Type: As indicated on the drawings.
   2. Transition Configuration: Open-transition (no neutral position).
   3. Voltage: As indicated on the drawings.
   4. Ampere Rating: As indicated on the drawings.
   5. Neutral Configuration: Solid neutral (unswitched), except as indicated.

F. Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).

G. Do not use double throw safety switches or other equipment not specifically designed for power

transfer applications and listed as transfer switch equipment.

H. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.

I. Switching Methods:
   1. Open Transition:
      a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.
      b. Where in-phase transfer is indicated, utilize in-phase monitor to initiate transfer when phase angle difference between sources is near zero to limit in-rush currents.

J. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.

K. Enclosures:
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1 or Type 12.
   2. Provide lockable door(s).
   3. Finish: Manufacturer's standard unless otherwise indicated.

L. Short Circuit Current Rating:
   1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating as indicated on the drawings.
   2. Short Time Rating: Where the requirement for selectivity is indicated, provide transfer switches with short time ratings suitable for the maximum short time delay setting of the supply side overcurrent protective device.

M. Automatic Transfer Switches:
   1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.
   2. Control Functions:
      a. Automatic mode.
      b. Test Mode: Simulates failure of primary/normal source.
      c. Voltage and Frequency Sensing:
         1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.
         2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.
         3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.
      d. Outputs:
         1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).
         2) Auxiliary contacts; two set(s) for each switch position.
         3) Signal before transfer (load disconnect) contacts; for selective load disconnection prior to transfer.
      e. Adjustable Time Delays:
         1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.
         2) Transfer to alternate/emergency source time delay.
         3) Retransfer to primary/normal source time delay.
         4) Signal before transfer (load disconnect) contact time delay.
         5) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.
      f. In-Phase Monitor (Open Transition Transfer Switches): Monitors phase angle difference between sources for initiating in-phase transfer.

g. Synchronization/In-Phase Monitor (Closed Transition Transfer Switches): Monitors voltage and phase angle difference between sources for initiating synchronized transfer.
h. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.
i. Retransfer to Normal Switch: Bypasses time delays for retransfer to primary/normal source.

3. Status Indications:
a. Connected to alternate/emergency source.
b. Connected to primary/normal source.
c. Alternate/emergency source available.
d. Primary/normal source available.

4. Alarm Indications for Closed Transition Transfer Switches:
a. Failure to synchronize.
b. Extended source interconnection/transfer switch locked out.

5. Other Features:
a. Event log.
b. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
c. Remote monitoring capability via PC.

6. Automatic Sequence of Operations:
a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.
b. Where applicable, initiate signal before transfer (load disconnect) contacts at programmable time before transfer.
c. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.
d. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.
e. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

N. Service Entrance Rated Transfer Switches:
1. Furnished with integral disconnecting and overcurrent protective device on the primary/normal source and with ground-fault protection where indicated.
2. Listed and labeled as suitable for use as service equipment according to UL 869A.

O. Remote Annunciators:
1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.
2. Transfer Switch Status Indications:
a. Connected to alternate/emergency source.
b. Connected to primary/normal source.
c. Alternate/emergency source available.
d. Primary/normal source available.

P. Interface with Other Work:
1. Interface with engine generators as specified in Section 26 3213.

2.03 AUTOMATIC TRANSFER SWITCH, AND BYPASS/ISOLATION SWITCHES

A. Automatic Transfer Switch (referred to hereinafter as “ATS”): Sizes and capacities as indicated and listed under UL-1008. ATS shall be mechanically held, electrically operated double throw type, with full capacity neutral terminals. Each ATS shall be completely factory assembled, factory wired, and ready for field installation. Each ATS shall include: relays; test switch to simulate normal power failure; pilot lights to indicate switch position; emergency generator starting contacts; other auxiliary contacts closed on normal and closed on emergency; ammeter and voltmeter with selector switches on the load side, and other necessary devices, all as

required to operate the switch as specified below.

1. Operation, each ATS shall have programmable microprocessor based controller to accomplish the following and provide sequence status and local source confirmation. When normal power voltage falls below 80 percent on any one phase, standby generator starting contacts shall close and start generator unit after an adjustable .5 - 3 second time delay to allow for momentary voltage dips. When emergency power reaches 90 percent of its rated voltage and frequency, ATS shall immediately transfer to emergency power. After an adjustable 0 - 30 minute time delay period follow restoration of normal power voltage to 90 percent on all phases, ATS shall transfer back to normal power. If emergency power fails during the time delay period, ATS shall return immediately to normal power. After ATS has retransferred to normal power, emergency generator shall continue to run at no load for a 15 minute period to allow it to cool, and then shall shut down.
2. ATS shall have load dump relay.
3. ATS shall have programmed return to normal.
4. ATS shall have phase angle monitoring and provide transfer during the “in phase” interval between generator and utility.
5. ATS shall have programmable exercising to operate as described in this section.
6. ATS shall have external means to interrupt electrical service to the plant without starting the generator. This device shall be protected from external operation except by authorized personnel.

2.04 SOURCE QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Perform production tests on transfer switches at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.
C. Verify that rough-ins for field connections are in the proper locations.
D. Verify that mounting surfaces are ready to receive transfer switches.
E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Arrange equipment to provide minimum clearances and required maintenance access.
D. Provide required support and attachment in accordance with Section 26 0529.
E. Install transfer switches plumb and level.
F. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 4 inch (100 mm) high concrete pad constructed in accordance with Section 03 3000.
G. Provide grounding and bonding in accordance with Section 26 0526.
H. Install automatic transfer switch(s) in accordance with the NFPA and as shown on the drawings.
I. Level and anchor the automatic transfer(s) switch to floor or wall.
J. Ground equipment as shown on the drawings and as required by NFPA 70.
K. Identify transfer switches and associated system wiring in accordance with Section 26 0553.

3.03 START UP AND TESTING

A. After the complete system has been installed, and before energizing the system, check all components of the system, including insulation resistance, phase to phase and phase to ground, complete electrical circuitry and safety features according to the manufacturer’s written instructions
B. After energizing circuits, test the interlocking sequence and operation of the complete system, including time delays of transfer from normal source to emergency and back to normal source, pick-up and voltage drop, and function of bypass/isolation switch in the presence of the Owner’s Representative prior to the final inspection.
C. When any defects are detected, correct the defects and repeat the test as requested by the Owner’s Representative, at no additional cost to the Owner.

3.04 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
C. Prepare and start system in accordance with manufacturer's instructions.
D. Automatic Transfer Switches:
    1. Inspect and test in accordance with NETA ATS, except Section 4.
    2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The insulation-resistance tests listed as optional are not required.
        a. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
E. Provide additional inspection and testing as required for completion of associated engine generator testing as specified in Section 26 3213.
F. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See *Division 01 79 00* - Closeout Submittals, for closeout submittals.
B. See *Division 01 80 00* - Demonstration and Training, for additional requirements.
C. Demonstration: Demonstrate proper operation of transfer switches to Owner, and correct deficiencies or make adjustments as directed.
D. Training: Train Owner's personnel on operation, adjustment, and maintenance of transfer switches.
    1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
    2. Provide minimum of four hours of training.
    3. Instructor: Manufacturer's authorized representative.
    4. Location: At project site.
E. Coordinate with related generator demonstration and training as specified in Section 26 3213.

3.07 PROTECTION

A. Protect installed transfer switches from subsequent construction operations.

3.08 MAINTENANCE

A. See *Division 01 70 00* - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
B. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of transfer switches for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.
C. Conduct site visit at least once every three months to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.
D. Provide trouble call-back service upon notification by Owner:
    1. Provide on-site response within 4 hours of notification.
    2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
    3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
E. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

DIVISION 26 20 00 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Strike (air) terminals and interconnecting conductors.
B. Grounding and bonding for lightning protection.

1.02 RELATED REQUIREMENTS

A. *Division 26 05 23* - Grounding and Bonding for Electrical Systems: Electrical system grounds.
B. Surge Protection for Wiring Systems: Specified in individual system requirements.

1.03 REFERENCE STANDARDS

A. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2023.
B. UL 96 - Lightning Protection Components; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination with Concrete Work: Coordinate the embedding of lightning protection components in concrete.
B. Coordination with Roofing Work: Ensure adequate attachment of strike terminals and conductors without damage to roofing.
C. Preinstallation Meeting: Convene a meeting at least at least two weeks prior to commencement of any work affected by lightning protection system requirements to discuss prerequisites and coordination required by other installers; require attendance by representatives of installers whose work will be affected.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate location and layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.
    1. Where conductors or grounds are to be embedded or concealed in other construction, submit shop drawings at least 30 days prior to start of construction.
    2. If concrete-encased grounds are to be used and are not shown in Contract Documents, provide sufficient data to determine concrete encasement dimensions and location.
    3. Include data on actual ground resistance determined by field measurement in accordance with NFPA 780.
    4. Include engineering analysis of equalization of potential to metal bodies within the structure.
    5. Include access panels, test holes, and disconnecting means for maintenance.
C. Product Data: Provide dimensions and materials of each component, indication of testing agency listing, and installation instructions.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
E. Installation Certification: Submit copy of certification agency's approval.
F. Operation and Maintenance Data: Provide recommended inspection and testing plan, including recommended intervals, to achieve periodic maintenance as recommended in NFPA 780; provide customized plan reflecting actual installation configuration with specific installed components identified.
G. Project Record Documents: Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

1.06 QUALITY ASSURANCE

A. Maintain one copy of each referenced system design standard on site.
B. Manufacturer Qualifications: Company specializing in lightning protection equipment with minimum three years' documented experience.
C. Designer Qualifications: Person or entity, employed by installer, who specializes in lightning protection system design with minimum three years' documented experience.
D. Installer Qualifications: Capable of providing the specified certification of the installed system.
E. Products: Listed, classified, and labeled as suitable for the purpose intended.
F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Lightning Protection Components:
   1. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
   2. Harger Lightning and Grounding: www.harger.com.
   3. National Lightning Protection Corporation: www.theprotectionsource.com.
   4. Robbins Lightning, Inc: www.robbinslightning.com.
   5. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 LIGHTNING PROTECTION SYSTEM

A. Lightning Protection System: Provide complete system complying with NFPA 780, including air terminals, bonding, interconnecting conductors and grounding electrodes.
   1. Provide system that protects:
   2. Coordinate with other grounding and bonding systems specified.
   3. Treat isolated non-grounded protruding metal items as specified by NFPA 780 for heavy-duty stacks.
   4. Determine ground resistance by field measurement.
   5. Provide copper, bronze, or stainless steel components, except where aluminum is allowed by NFPA 780.
   6. Provide disconnecting means and access panels or similar devices to allow complete periodic inspection and testing as described by NFPA 780 Annex D.
   7. Provide system certified by Underwriters Laboratories or the Lightning Protection Institute.

B. Strike Terminals: Provide strike (air) terminals on the following:
   1. Roofs.
   2. Parapets.
   3. Roof mounted equipment.

2.03 COMPONENTS

A. All Components: Complying with applicable requirements of UL 96.
B. Strike (Air) Terminals: Copper, solid, with adhesive bases for single-ply roof installations.
C. Strike Terminal for Chimney: Lead-coated copper.
D. Decorations: Ball.
E. Grounding Rods: Solid copper.
F. Ground Plate: Copper.
G. Conductors: Copper cable.
H. Connectors and Splicers: Bronze.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated on shop drawings.
B. Coordinate work with installation of roofing and exterior and interior finishes.

3.02 INSTALLATION

A. Install in accordance with referenced system standards and as required for specified certification.
B. Connect conductors using mechanical connectors or exothermic welding process; protect adjacent construction elements and finishes from damage.

3.03 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Perform field inspection in accordance with *Division 01 40 00*.
C. Perform visual inspection as specified in NFPA 780 as if this were a periodic follow-up inspection.
D. Perform continuity testing as specified in NFPA 780 as if this were testing for periodic maintenance.
E. Obtain the services of the specified certification agency to provide inspection and certification of the lightning protection system, including performance of any other testing required by that agency.

DIVISION 26 40 00 - SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surge protective devices for service entrance locations.
B. Surge protective devices for distribution locations.
C. Surge protective devices for branch panelboard locations.
D. Extent of surge protection devices as indicated by drawings and schedules.

1.02 RELATED REQUIREMENTS

A. *Division 26 05 23* - Grounding and Bonding for Electrical Systems.
B. *Division 26 09 20* - Switchboards.
C. *Division 26 05 40* - Panelboards.

1.03 ABBREVIATIONS AND ACRONYMS

A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.
B. SPD: Surge Protective Device.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.
    1. SPDs with EMI/RFI filter: Include noise attenuation performance.
C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.
D. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
    1. UL 1449.
    2. UL 1283 (for Type 2 SPDs).
    3. UL 248 listing for internal fusing.
E. Field Quality Control Test Reports.
F. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
G. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.
H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
I. Project Record Documents: Record actual connections and locations of surge protective devices.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years' documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Provide minimum ten year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.
C. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

1.10 SEISMIC QUALIFICATIONS

A. Provide Seismic tested equipment as follows for equipment installed internal to switchboards, Panelboards, and Motor Control Centers:
   1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the International Building Code (IBC) with seismic values as determined by structural sheet S0.1.
B. For equipment installed external to Switchboards, Panelboards, and Motor Control Centers the following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
   1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil/structural engineer in the state of the project. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
   2. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation; SPD Series (internally mounted).
B. GE; Tranquell (internally mounted).
C. Field-installed, Externally Mounted Surge Protective Devices:
   1. Current Technology; a brand of Thomas & Betts Power Solutions; Select SL3; or approved equal: www.tnbpowersolutions.com.
D. Factory-installed, Internally Mounted Surge Protective Devices:
   1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.
E. Substitutions: See *Division 01 60 00* - Product Requirements.
F. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
B. Protected Modes:
   1. Wye Systems: L-N, L-G, N-G, L-L.
C. UL 1449 Voltage Protection Ratings (VPRs):
   1. 208Y/120V System Voltage: Not more than 700 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
   2. 480Y/277V System Voltage: Not more than 1,200 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.
D. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
E. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   1. Indoor clean, dry locations: Type 12.
F. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
   1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.
   2. Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.
G. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a

complete assembly including SPD.
1. Switchboards: See *Division 26 09 20*.
2. Panelboards: See *Division 26 05 40*.

2.03 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
B. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
D. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.
E. Repetitive Surge Current Capacity: Not less than 5,000 impulses.
F. UL 1449 Nominal Discharge Current (I-n): 20 kA.
G. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
H. EMI/RFI Filtering: Provide EMI/RFI filter to attenuate electrical noise; listed as complying with UL 1283 for Type 2 SPDs (UL 1283 listing not available for Type 1 SPDs).
   1. Noise Attenuation: Not less than 44 dB at 100 kHz using MIL-STD-220 insertion loss test method.
I. Diagnostics:
   1. Protection Status Monitoring: Provide indicator lights to report the protection for each phase.
   2. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
   3. Remote Status Monitoring: Provide Form C dry type contacts (normally open and normally closed) for remote annunciation of status.
   4. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six-digit LCD display that indicates quantity of surge events.
J. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.04 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
B. List and label as complying with UL 1449, Type 1 or Type 2.
C. Distribution locations include SPDs connected to distribution panelboards and motor control centers.
D. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
E. Surge Current Rating: Not less than 80 kA per mode/160 kA per phase.
F. Repetitive Surge Current Capacity: Not less than 5,000 impulses.
G. UL 1449 Nominal Discharge Current (I-n): 20 kA.
H. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
I. EMI/RFI Filtering: Provide EMI/RFI filter to attenuate electrical noise; listed as complying with UL 1283 for Type 2 SPDs (UL 1283 listing not available for Type 1 SPDs).
   1. Noise Attenuation: Not less than 44 dB at 100 kHz using MIL-STD-220 insertion loss test method.
J. Diagnostics:
   1. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.
   2. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
   3. Remote Status Monitoring: Provide Form C dry type contacts (normally open and normally closed) for remote annunciation of status.
   4. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.
K. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit

breaker or fused switch or not direct bus connected.

2.05 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
B. List and label as complying with UL 1449, Type 1 or Type 2.
C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
D. Surge Current Rating: Not less than 60 kA per mode/120 kA per phase.
E. Repetitive Surge Current Capacity: Not less than 5,000 impulses.
F. UL 1449 Nominal Discharge Current (I-n): 20 kA.
G. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
H. EMI/RFI Filtering: Provide EMI/RFI filter to attenuate electrical noise; listed as complying with UL 1283 for Type 2 SPDs (UL 1283 listing not available for Type 1 SPDs).
    1. Noise Attenuation: Not less than 44 dB at 100 kHz using MIL-STD-220 insertion loss test method.
I. Diagnostics:
    1. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.
    2. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
    3. Remote Status Monitoring: Provide Form C dry type contacts (normally open and normally closed) for remote annunciation of status.
    4. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.
J. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.
D. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.
E. Provide conductors with minimum ampacity as required by NFPA 70, as required by NFPA 70, and as required by NFPA 70.
F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.
G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.
H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.
I. Install SPD equipment where indicated on the drawings.

3.03 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Perform inspection, testing, and adjusting in accordance with *Division 01 40 00*.
C. Inspect and test in accordance with NETA ATS, except Section 4.
D. Perform inspections and tests listed in NETA ATS Section 7.19.1.
E. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.04 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

DIVISION 26 50 00 - LIGHTING

GENERAL

These requirements pertain to all interior, exterior canopy and exterior building lighting. Coordinate site lighting requirements with Owner. All lighting systems shall be designed based on Illuminating Engineering Society (IES), ANSI schoolhouse lighting standards, and the current adopted building codes. Discuss lighting ideas and control strategies with Owner before design and layout of lighting systems.

All interior and exterior fixtures MUST meet the following:

1.) Be UL Listed
2.) Have a 5-year or greater Manufacturer's warranty
3.) Have a local representative for warranty purposes (no internet sourced fixtures)
4.) Be DLC Certified, DLC Premium Certified is preferred

INTERIOR LIGHTING: Classrooms, Cafetorium's, and office areas to have Occupancy and Light Harvesting controls, in accordance with current IECC codes. Lighting in all areas to have a minimum of one fixture with battery backup nearest to exit door, this includes all offices and restrooms, large areas with multiple exit doors to have a fixture with battery backup near each door. All fixtures to be controlled by a lighting control system such as the Acuity n-Light Air or Lutron Vive system, or approved equal that must be Bacnet compatible to be considered. Classrooms shall have a “multi- scene” controller to control lights where projectors or Promethean boards are used. Hallways to have sufficient motion control devices to adequately control lighting. Interior lighting shall be 4K color temperature.

Fixture design for all interior lighting is based on the Litonia BLT series Single Basket Volumetric Troffers with a smooth curved lens. Similar fixtures are acceptable but must be approved by MSCS.

SITE LIGHTING: All fixtures should have vandal-resistant lenses and be controlled by a time clock, or other appropriate energy conserving controllers, installed in an easily accessible interior location. Ordinary wood poles and “cobra” fixtures should only be used in extreme budget constrained cases. Aluminum poles and “box” type fixtures should be used where proximity to the building makes a more attractive pole and fixture desirable. Energy efficient (LED) wall mounted fixtures are normally used to light the areas around the building. Shielded lighting may be required to provide cutoff at property lines. All wall mounted fixtures to be sealed with silicone between the fixture and wall to prevent water and insect intrusion. Exterior lighting shall be 5K color temperature.

PHYSICAL EDUCATION LIGHTING: High efficiency LED fixtures providing natural color light should be specified. Guards will be required over all fixtures. Foot-candle level shall be as recommended for a gymnasium by TSSAA for basketball, volleyball, and wrestling.
Locate light fixtures in stairwells that is conducive to the paths of travel and do not impede paths of travel. All stairwell lighting must require no more than a 10-foot ladder for repair.

Incandescent lighting shall not be used except for special utility lighting, as approved by the Owner.
Stage and Studio lighting shall be LED.
No HID fixtures shall be specified.

LED lighting shall be used as the basis of design. Any other type of lighting must be owner approved. Each space with designated occupancy shall have a lighting occupancy sensor. Use of warm-up fixtures is not permitted.

Exterior lighting shall be provided for building entrances, parking lots, outdoor storage areas, loading docks, bus ports, covered walkways, exterior mechanical room doors and other outdoor areas where in the judgment of the engineer or Owner, lighting is required for night functions, security, or safety.

ILLUMINATION LEVELS: Illumination levels shall meet or exceed the current adopted building codes. As a basis-of- design, use Illuminating Engineering Society handbook as a guide. Lighting calculations shall be based on room surface reflectance for interior finishes selected by the architect, which in all cases shall not be less than the following for instructional areas:
Ceiling - 80 percent Wall - 50 percent Floor - 20 percent

Be aware of lighting codes relative to adjacent properties. (See Zoning Code Chapter 17). Since lighting technology is constantly changing, special designs not strictly adhering to the preceding recommended light levels but still meeting the lighting needs in the designer's opinion, will not be prohibited but shall have prior approval of the Owner.

EXIT SIGNS: LED exit and directional signs shall be provided with individual battery back-up power. Exit signs and directional signs should be wall-mounted where possible in lieu of ceiling-mounted.

EMERGENCY LIGHTING: Emergency lighting shall be provided. Use of 2X4, or 2X2 fixtures with battery backup is preferred where applicable. The primary source may be connected at any point within the normal lighting system. The secondary source shall operate automatically upon interruption of the primary source and shall be self-contained batteries. The areas listed shall have emergency illumination, whether having natural lighting or not, and are as follows, but not limited to:

- Exits and exit access corridors
- Small and large assembly areas
- Areas occupied by over 50 persons
- Gymnasium dressing rooms Band and choral rooms
- Career Technical Education spaces
- Administration or other building control centers
- Kitchens
- Group toilets
- Main electrical service disconnect location
- Emergency power equipment location

LIGHTING SYSTEM SECURITY: All practical measures should be taken to provide protection for lighting fixtures and equipment. Vandal-resistant materials or metal guards shall be used for fixtures that can be reached from floors, in P.E. rooms and gymnasiums, and at all outdoor locations. Metal guards shall be mounted to walls with masonry wall anchors.

Mounting heights should be specified to afford protection, consistent with ease of maintenance.

Designer shall certify the foot-candle levels at the completion of the project and provide report to Owner as part of closeout.

DIVISION 26 50 10 – LED INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.
B. Exit signs.
C. Drivers.
D. Lamps
E. LEDs and LED Arrays.
F. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. *Division 26 05 50* - Identification for Electrical Systems: Identification of products and requirements.
B. *Division 26 05 30* - Wiring Devices.
C. *Division 26 60 00* - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. ANSI/NEMA C78.50-2014 - American National Standard for Electric Lamps - Assigned LED Lamp Codes.
B. ANSI/NEMA C78.79-2014 - American National Standard for Electric Lamps - Nomenclature For Envelope Shapes Intended For Use With Electric Lamps.
C. ANSI/NEMA C78.377-2015 - American National Standard For Electric Lamps - Specification For The Chromaticity Of Solid State Lighting (SSL) Products.
D. ANSI/NEMA C82.77-2002 - American National Standard For Harmonic Emission Limits - Related Power Quality Requirements For Lighting Equipment.
E. ANSI/NEMA C82.77/5-2015 - American National Standard For Lighting Equipment - Voltage Surge Requirements.
F. ANSI/NEMA C82.77.10-2104 - American National Standard For Lighting Equipment - Harmonic Emissions Limits - Related Power Quality Requirements.
G. ASTM A1008/A1008M (2013) - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength, Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened.
H. ASTM A580/A580M (2014) - Standard Specification for Stainless Steel Wire.
I. ASTM A641/A641M (2009a; R 2014) - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
J. ASTM A653/A653M (2013) - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
K. ASTM B164 (2003; R 2014) - Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
L. ASTM B633 (2013) - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
M. ASTM E2129 (2010) - Standard Practice for Data Collection for Sustainability Assessment of Building Products.
N. CALIFORNIA ENERGY COMMISSION (CEC) - CEC Title 24 (2008; Effective Jan 2010) - California's Energy Efficiency Standards for Residential and Nonresidential Buildings.
O. CIE TC1-62 - Color Rendering Of White LED Light Sources: CIE 177:2007.
P. ENERGY STAR (1992; R 2006) - Energy Star Energy Efficiency Labeling System (FEMP).
Q. Green Seal GS-12 (1997) - Occupancy Sensors.
R. IEEE 100 (2000; ARCHIVED) - The Authoritative Dictionary Of IEEE Standard Terms.
S. IEEE C62.41.1 (2002; R 2008) - Guide On The Surges Environment In Low-Voltage (1000V and Less) AC Power Circuits.
T. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits; Institute of Electrical and Electronic Engineers; 2002 (Cor 1, 2012).
U. IES LM-15-03 - Guide For Reporting General Lighting Equipment Engineering Data For Indoor Luminaires (Reaffirmed 2011).
V. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; Illuminating Engineering Society; 2002 (Reaffirmed 2008).
W. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting

Products; Illuminating Engineering Society; 2008.

X. IES LM-80 - Approved Method: Measuring Lumen Maintenance Of LED Light Sources; Illuminating Engineering Society; 2008.
Y. IES LM-82-12 - Characterization Of LED Light Engines And LED Lamps For Electrical And Photometric Properties As A Function Of Temperature.
Z. IES LM-84-14 - IES Approved Method For Measuring Luminous Flux And Color Maintenance Of LED Lamps, Light Engines, And Luminaires.
AA. IES LM-85-14 - IES Approved Method For Electrical & Photometric Measurements Of High Power LEDS.
BB. IES TM-21-11 - Projecting Long Term Lumen Maintenance Of LED Light Sources + Addendum B.
CC. IES TM-30-15 - IES Method for Evaluating Light Source Color Rendition.
DD. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
EE. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association; 2006.
FF. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association; 2006.
GG. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; National Electrical Manufacturers Association; 2012.
HH. NEMA LE 6-2014 - Procedure For Determining Target Efficacy Ratings For Commercial, Industrial, and Residential Luminaires.
II. NEMA SSL 1-2010 - Electronic Drivers For LED Devices, Arrays, Or Systems.
JJ. NEMA SSL 3-2010 - High-Power White LED Binning For General Illumination.
KK. NEMA SSL 4-2012 - Retrofit Lamps: Minimum Performance Requirements.
LL. NEMA SSL 6-2010 - Solid State Lighting For Incandescent Replacement - Dimming (With Errata).
MM. NEMA SSL 7A-2015 - Phase-Cut Dimming For Solid State Lighting-Basic Compatibility.
NN. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; National Electrical Manufacturers Association; 2015.
OO. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
PP. NFPA 101 - Life Safety Code; National Fire Protection Association; 2015.
QQ. UL 496 - Lampholders.
RR. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
SS. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
TT. UL 1574 - Standard for Track Lighting Systems.
UU. UL 1598 - Luminaires; Current Edition, Including All Revisions.
VV. UL 2108 - Standard for Low Voltage Lighting Systems.
WW. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.
XX. UL 8752 - Organic Light Emitting Diode (OLED) Panels.
YY. UL 8754 - Holders, Bases, and Connectors for Solid-State (LED) Light Engines and Arrays.

1.04 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
B. Average life: The time after which 50 percent will have failed and 50 percent will have survived under normal conditions.
C. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.
D. CCT: Correlated Color Temperature.
E. CRI: Color Rendering Index. Based on CIE Test Color Method.
F. DLC: Design Light Consortium.
G. Duv: Delta u'v' per TM-30-15.

H. EELRP: Energy Efficient Lighting Products Program.
I. Fixture: Lighting Fixture. Equivalent to Luminaire.
J. IP: International Protection or Ingress Protection Rating.
K. Lamp: Self-contained assembly of LED chips and power electronics. Contained in a protective cover with heat sink, lens and reflector. Connected directly to a power source in the field via compatible socket in the luminaire.
L. LED: Light-Emitting Diode.
M. Lifetime: Luminaire performance life measured as the amount of time for lumen output to reach specified percentage. Example: L70 indicates 70% of output with hours indicated to reach that 70% output.
N. Lumen: Measured output of lamp and luminaire, or both.
O. Luminaire: Complete lighting assembly, including lamp, reflector, accessories, housing and mounting equipment. Equivalent to Lighting Fixture.
P. NIST: National Institute of Standards and Technology.
Q. NRTL: Nationally Recognized Testing Laboratory. Independent testing organization accredited under the NVLAP for the EELRP, administered by NIST.
R. NVLAP: National Voluntary Laboratory Accreditation Program
S. Ra: Color Rendering Index, also CIE Ra.
T. Rf: Fidelity Index per TM-30.
U. Rg: Gamut Index per TM-30.
V. SDCM: Standard Deviation Color Matching. Also known as MacAdam Ellispse.
W. TER: Target Efficacy Rating. Replaces Luminaire Efficacy Rating (LER) of NEMA 5.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
   2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
   3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
   4. Notify Architect/Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.06 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Shop Drawings:
   1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
   2. Provide photometric calculations where luminaires are proposed for substitution. Photometric calculations shall be provided electronically utilizing Visual lighting software.
C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features. Indicate luminaire Type on each page of the data sheet. Indicate options with boxes or lines.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.
      b. Include IES LM-79 test report upon request.
   2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.
   3. Drivers: Include wiring diagrams and list of compatible LED Arrays or Lamps.
   4. LED Arrays and Chips: Include rated life, color temperature (CCT), color rendering index (CRI), and initial and mean lumen output.

D. Samples:
   1. Provide one sample(s) of each luminaire proposed for substitution upon request.
   2. Provide one sample(s) of each product finish illustrating color and texture upon request.
E. Certificates for Drivers: Manufacturer's documentation of compatibility with dimming controls to be installed.
F. Field Quality Control Reports.
G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
H. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
D. Product Listing Organization Qualifications: An organization recognized by OSHA in 29 CFR 1910.7 as a Nationally Recognized Testing Laboratory (NRTL), accredited under the NVLAP for Energy Efficient Lighting Products and acceptable to authorities having jurisdiction.
E. Color Quality: LED Array to provide color quality
   1. CCT: Correlated Color Temperature shall meet the requirements of IES-LM79 and IES LM-80 and be within 25K of the temperature specified in the Luminaire Schedule
   2. CRI: CRI shall be in accordance with CIE
   3. TM-30: Color quality to meet minimum metrics specified.
   4. Color Stability: Color stability / shift shall comply with Energy Star. Measured ?u'v' of 9 out of 10 shall be no more than 0.007 over the first 6000 hours of LED operation.
   5. Binning: Each luminaire type shall be binned within three-step MacAdam Ellipse (3.0 SDCM) ensure color consistency among luminaires.
F. Design Light Consortium: Products shall be listed by DLC.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.
B. Provide five-year manufacturer warranty for all LED luminaires, including drivers.
C. Provide five-year pro-rata warranty for batteries for emergency lighting units.
D. Provide ten-year pro-rata warranty for batteries for self-powered exit signs.
E. Provide three-year full warranty for emergency power supply units.

PART 2 PRODUCTS

2.01 MANUFACTURERS - LUMINAIRES

A. Furnish products by the manufacturer listed in the Luminaire Schedule. Substitution of equivalent products shall be submitted for approval. Substitutions shall be manufactured by the following:
   1. Fluxwerx: www.fluxwerx.com
   2. Acuity Brands, Inc: www.acuitybrands.com.
   3. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com.
   4. Signify: www.signify.com

B. Specific luminaire types have acceptable manufacturers listed under the description as defined below. Substitutions shall be one of those listed.
C. Substitutions: See *Division 01 60 00* - Product Requirements, except where individual luminaire types are designated with substitutions not permitted.

2.02 LUMINAIRES

A. Furnish products as indicated in Luminaire Schedule included on the drawings. Product information is the basis of design for quality and performance as defined below.
B. General Requirements:
1. Provide products that comply with requirements of NFPA 70.
2. Provide products that are listed and labeled as complying with UL 1598, where applicable.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Components: UL 8750 recognized or listed as applicable.
5. Tested in accordance with IES LM-79 and IES LM-80.
6. LED Estimated Useful Life: Minimum of 65,000 hours at 80 percent lumen maintenance, calculated based on IES LM-80 test data.
7. Provide products complying with Federal Energy Management Program (FEMP) requirements.
8. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
9. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
10. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
11. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning
12. Materials
a. Metal Parts:
1) Free of burrs and sharp corners and edges.
2) Sheet metal components shall be steel unless otherwise indicated.
3) Form and support to prevent warping and sagging.
b. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
c. Diffusers and Globes:
1) Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2) Glass: Annealed crystal glass unless otherwise indicated.
3) Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
d. Housings:
1) [Extruded-aluminum] housing and heat sink.
e. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
f. Label shall include the following lamp characteristics:
1) "USE ONLY" and include specific lamp type.
2) Lamp diameter, shape, size, wattage, and coating.
3) CCT and CRI for all luminaires.
g. Metal Finishes
1) Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

13. Luminaire Support
    a. Comply with requirements in *Division 26 05 25* "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
    b. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
    c. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, [12 gage (2.68 mm)] [Insert size].
    d. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
    e. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

C. Type: Letter or letter/number combination indicated on the plans adjacent to luminaire symbols. These Types to be indicated in the Submittals.
D. Manufacturer: Luminaire manufacturer Basis of Design. See Section 2.1.
E. Model: Luminaire manufacturers' model numbers. Model number shown to define design intent. Should a discrepancy occur with the requirements in the Luminaire Schedule or Specifications, the qualities in the Schedule shall be used.
F. Description: Description of luminaire type with requirements as follows:
    1. Cylinder
        a. Wall or surface mounted luminaire for direct lighting either up, down or both. Shape is a long cylinder and a circular or square cross section with a nominal aperture diameter of 6 inches or as Scheduled. Internal baffle to direct light and reduce glare.
        b. Body: Aluminum housing with hidden fasteners.
        c. Finish: Factory painted with enamel epoxy paint with color as indicated.
        d. Mounting:
            1) Ceiling: Suspend by 3/8-inch IPS pipe to house power and control cable.
            2) Wall: Rectangular arm, 2 inches or less long, on cover plate and frame designed for 3-1/2-inch, 4 inch or single gang switch outlet box.
        e. Optical Assembly: Combination of lens and reflector just below the LED light engine used to shape the light emitted from the LED diodes.
        f. Lens: Frosted glass white in color that obscures yellow LED diode when de-energized. Can be part of an optical assembly.
        g. Reflector: Spun aluminum aperture and trim regressed at least 2 inches deep and finished as follows:
            1) Specular reflector: Anodized aluminum with 96% reflectivity, minimum.
            2) Painted reflector: Matte white aluminum with 85% reflectivity, minimum.
            3) Can be part of an optical assembly.
            4) Trim and aperture to be one piece with the same finish.
        h. Baffles: Aluminum, finished to match reflector.
    2. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.
    3. Linear Indirect/Direct
        a. Linear luminaire suspended from ceiling for general area lighting. Indirect lighting reflected from ceiling for diffuse illumination of ceiling. Unit luminaires in lengths as Scheduled. Continuous lengths as scheduled.
        b. Housing: extruded aluminum.
        c. Finish: Baked enamel gloss white paint.
        d. Reflector: 90% reflective internal reflector to create batwing distribution.
        e. Lens: Satin acrylic lens to eliminate point source glare on ceiling reflective surface.
    4. Recessed Downlight
        a. Round or square luminaire fully recessed into ceiling with a nominal aperture diameter of 6 inches.
        b. Ceiling Compatibility: Comply with NEMA LE 4.
        c. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.

d. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
e. Luminaire to be accessible and maintainable from both above and below. Maintenance shall not require removal of surrounding finishes.
f. Optical Assembly: Combination of lens and reflector just below the LED light engine used to shape the light emitted from the LED diodes.
g. Lens: Frosted glass white in color that obscures yellow LED diode when de-energized. Can be part of an optical assembly.
h. Reflector: Spun aluminum aperture and trim regressed at least 2 inches deep and finished as follows”
    1) Specular reflector: Anodized aluminum with 96% reflectivity, minimum.
    2) Painted reflector: Matte white aluminum with 85% reflectivity, minimum.
    3) Can be part of an optical assembly.
    4) Trim and aperture to be one piece with the same finish.
i. Baffles: Aluminum, finished to match reflector.

5. Recessed Linear
    a. Rectangular recessed fixture.
    b. Housing: Cold-rolled steel above ceiling.
    c. Internal reflector: steel with matte white powder coat paint; 90% reflectivity.
    d. Trim: Extruded aluminum suitable for mounting. 5/8 inch for gypsum, flanged mount. Fitted to acoustical ceiling grid system where located.
    e. Finish: Gloss white enamel paint.
    f. Lens: Satin acrylic, seamless end to end regardless of overall length.
6. Recessed Troffer:
    a. Ceiling Compatibility: Comply with NEMA LE 4.
    b. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
    c. Housing: Stamped steel sheet metal, deburred with cut-free edges.
    d. Finish: Paint after fabrication. Gloss white enamel interior and exterior.
    e. Lens:
        1) General Purpose: Prismatic acrylic, flat A12125
        2) Architectural: Satin acrylic, smooth curve. 3)
7. Strip Light, General Purpose
    a. General purpose luminaire.
    b. Housing: Stamped steel sheet metal, deburred with cut-free edges.
    c. Lens: Frosted acrylic
    d. Mounting: surface mounted on wall or ceiling as indicated. Chain-hung for suspended applications.
8. Surface Linear
    a. Rectangular fixture.
    b. Housing: Extruded aluminum.
    c. Internal reflector: steel with matte white powder coat paint; or aluminum with natural finish; minimum 90% reflectivity.
    d. Trim: Extruded aluminum finished to match housing.
    e. Lens: Satin acrylic, seamless end to end regardless of overall length.
9. Undercounter
    a. Unit fixture with extruded aluminum body, lens and modular power connectors each end. Multiple lengths to accommodate conditions under cabinets. Available lengths shall include 5, 7, 11, 17, 23, and 47 inches to account for fitting between cabinet frames. Nominal cross sectional no greater than 1 inch deep and 4 inches wide.
    b. Housing: extruded aluminum.
    c. Lens: Satin acrylic
    d. Mounting: Directly to surface.
    e. Electrical: Factory-furnished cords of various lengths rated for the voltage and power carried. Connect end to end without unnecessary lengths. Provide power supply with capacity to serve modules daisy-chained together.

10. Exit Signs
    a. Manufacturers
        1) Acuity Brands, Inc: www.acuitybrands.com.
        2) Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com.
        3) Signify: www.signify.com
        4) Substitutions: See *Division 01 60 00* - Product Requirements.
    b. Description (All Exit Signs): Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
        1) Number of Faces: Single or double as indicated or as required for the installed location.
        2) Directional Arrows: As indicated or as required for the installed location.
    c. Accessories:
        1) Provide compatible accessory high impact polycarbonate vandal shields where indicated.
        2) Provide compatible accessory wire guards where indicated.

G. Lumens: Provide delivered lumens to within 5% of that scheduled.
H. Color: Provide light color and quality specified as follows:
    1. CCT: Within 50K of value scheduled.
    2. CIE standard metrics:
        a. CRI: Within 5% of value scheduled. 82 minimum.
        b. R9: Within 1% of scheduled value. 15 minimum.
    3. TM-30 standard metric, where indicated:
        a. Rf: Within 2% of value scheduled. 85 minimum.
        b. Rg: Within 2% of value scheduled. 85 minimum.
        c. Duv:Within 0.0001 of scheduled value, 0,001 minimum.

2.03 DRIVERS

A. Manufacturers:
    1. EldoLED
    2. Lutron Electronics Company, Inc; www.lutron.com. <http://www.lutron.com/>
    3. Philips Lighting Electronics/Advance: www.advance.philips.com. <http://www.advance.philips.com/>
    4. Substitutions: See *Division 01 60 00* - Product Requirements.
    5. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.
    6. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.
B. All Drivers - General Requirements:
    1. Provide drivers containing no polychlorinated biphenyls (PCBs).
    2. Minimum Efficiency/Efficacy: Provide drivers complying with all current applicable federal and state driver efficiency/efficacy standards.
C. LED Drivers:
    1. All LED Drivers: Unless otherwise indicated, provide high frequency electronic drivers complying with ANSI C82.11 and listed and labeled as complying with UL 935.
        a. Inrush Current: No greater than 1mA. Never to exceed peak currents specified in NEMA 410.
        b. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of plus or minus 10 percent.
        c. Total Harmonic Distortion: Not greater than 15 percent.
        d. Power Factor: Not less than 0.95.
        e. Sound Rating: Class A, suitable for average ambient noise level of 20 to 24 decibels.
        f. LED Board Compatibility: Specifically designed for use with the specified LED Board, with no visible flicker.
        g. LED Board Dimming Compatibility:
        h. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category A.

i. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class A, non-consumer application.

D. Dimmable LED Drivers:
1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
2. Control Compatibility: Fully compatible with the dimming controls to be installed.
a. Wall Dimmers: See *Division 26 05 30*.

2.04 LAMPS

A. Manufacturers:
1. General Electric Company/GE Lighting: www.gelighting.com.
2. Osram Sylvania: www.sylvania.com.
3. Philips Lighting Company: www.lighting.philips.com.
4. Substitutions: See *Division 01 60 00* - Product Requirements.
5. Manufacturer Limitations: Where possible, provide lamps produced by a single manufacturer.
6. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.

B. Lamps - General Requirements:
1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect/Engineer to be inconsistent in perceived color temperature.

2.05 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.

B. Install products according to manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship), NECA 500 (commercial lighting), and NECA 502 (industrial lighting).

D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

E. Furnish and install all necessary structural supports, U-Channel strut system, chains, rods, hangers, bolts, etc., to properly support the fixtures from the building structure, as indicated on the drawings or as recommended by the manufacturer. (See Sections 26 0529 and 26 0533.01 of this division of the specifications).

F. Luminaires shall only be installed after rough-in wiring is complete. Luminaires shall be stored in

their original cartons and protected from damage until the final installation is made. Luminaires damaged during storage or installation must be removed and replaced with new fixtures.

G. Luminaire whips shall be no less current carrying capacity than #14 AWG with separate ground in lengths, per NEC. The whip shall not be used to extend to additional luminaires

H. Luminaires shall be mounted to comply with the seismic requirements of the International Building Code. See sheet S0.1 for seismic requirements.

I. Suspended Ceiling Mounted Luminaires:
   1. Do not use ceiling tiles to bear weight of luminaires.
   2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
   3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
   4. Secure pendant-mounted luminaires to building structure.
   5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
   6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
   7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

J. Recessed Luminaires:
   1. Install trims tight to mounting surface with no visible light leakage.
   2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
   3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

K. Suspended Luminaires:
   1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
   2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
   3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet in length, with no more than 4 feet between supports.
   4. Install canopies tight to mounting surface.
   5. Unless otherwise indicated, support pendants from swivel hangers.

L. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

M. Install accessories furnished with each luminaire.

N. Bond products and metal accessories to branch circuit equipment grounding conductor.

O. Luminaires Controlled by Dual-Level Switching: Connect such that each switch controls the same corresponding driver in each luminaire.

P. Exit Signs:
   1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
   2. Install lock-on device on branch circuit breaker serving units.

Q. Remote Drivers Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.

R. Identify luminaires connected to emergency power system in accordance with Section 26 0553.

S. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Test self-powered exit signs, emergency lighting units, and emergency power supply units to verify proper operation upon loss of normal power supply.

E. Correct wiring deficiencies and repair or replace damaged or defective products.

F. Coordinate with other trades the final location of luminaires shown diagrammatically on the

drawings in order to avoid interferences. Relocate luminaires, as required by the Architect/Engineer, as part of the work under this Division if new location is within 5-foot radius of location shown.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect/Engineer. Secure locking fittings in place.

B. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect/Engineer or authority having jurisdiction.

3.06 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See *Division 01 79 00* - Closeout Submittals, for closeout submittals.

B. See *Division 01 80 00* - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of luminaires to Architect/Engineer, and correct deficiencies or make adjustments as directed.

D. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

DIVISION 26 50 20 – EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior luminaires.

B. Poles and accessories.

C. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.

B. *Division 26 05 23* - Grounding and Bonding for Electrical Systems.

C. *Division 26 05 10* - Boxes for Electrical Systems.

D. *Division 26 05 40* - Lighting Control Panelboards.

E. *Division 26 05 30* - Wiring Devices: Receptacles for installation in poles.

F. *Division 26 50 10* – LED Interior Lighting./Engineer

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
2. Notify Architect/Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Shop Drawings:

1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
2. Provide photometric calculations where luminaires are proposed for substitution. Photometric calculation shall be performed with Visual Lighting software and shall be submitted electronically.
3. Provide structural calculations for each pole proposed for substitution.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:
    a. Include estimated useful life, calculated based on IES LM-80 test data.
    b. Include IES LM-79 test report upon request.
2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
3. Lamps: Include rated life and initial and mean lumen output.
4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.

D. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.
E. Field Quality Control Reports.
    1. Include test report indicating measured illumination levels.
F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See *Division 01 60 00* - Product Requirements, for additional provisions.
    2. Touch-Up Paint: 2 gallons (8 liters), to match color of pole finish.
I. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.
D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.07 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.
B. Provide five-year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.01 LUMINAIRES

A. Furnish products as indicated in luminaire schedule included on the drawings.
B. Provide products that comply with requirements of NFPA 70.
C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
D. Provide products listed, classified, and labeled as suitable for the purpose intended.
E. Unless otherwise indicated, provide complete luminaires including LED array, driver, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
H. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
I. Recessed Luminaires:
    1. Ceiling Compatibility: Comply with NEMA LE 4.

2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

J. LED Luminaires:
1. Components: UL 8750 recognized or listed as applicable.
2. Tested in accordance with IES LM-79 and IES LM-80.
3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

K. Exposed Hardware: Stainless steel.

2.02 POLES

A. Manufacturers:
1. Acuity Brands, Inc: www.acuitybrands.com.
2. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com.
3. Gardco a division of Signify: www.signify.com Gardco.
4. Substitutions: *Division 01 25 00* - Substitution Procedures

B. All Poles:
1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
2. Structural Design Criteria:
a. Comply with AASHTO LTS.
b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
1) Design Wind Speed: 100 miles per hour, with gust factor of 1.3.
c. Dead Load: Include weight of proposed luminaire(s) and associated supports and accessories.
d. Include structural calculations demonstrating compliance with submittals.
3. Material: Steel, unless otherwise indicated.
4. Shape: Square straight, unless otherwise indicated.
5. Finish: Match luminaire finish, unless otherwise indicated.
6. Mounting Height: as indicated on drawings, unless otherwise indicated.
7. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
8. Unless otherwise indicated, provide with the following features/accessories:
a. Top cap.
b. Handhole.
c. Anchor bolts with leveling nuts or leveling shims.
d. Anchor base cover.
e. Provision for pole-mounted weatherproof GFI receptacle where indicated.
f. Brackets: where indicated.
g. Pole-top tenon, where indicated.

C. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

2.03 ACCESSORIES

A. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
C. Verify that suitable support frames are installed where required.
D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.
B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
B. Install products in accordance with manufacturer's instructions.
C. Install luminaires in accordance with NECA/IESNA 501.
D. Provide required support and attachment in accordance with Section 26 0529.
E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
F. Recessed Luminaires:
    1. Install trims tight to mounting surface with no visible light leakage.
    2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
    3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
G. Suspended Luminaires:
    1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
    2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
    3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet in length, with no more than 4 feet (1.2 m) between supports.
    4. Install canopies tight to mounting surface.
    5. Unless otherwise indicated, support pendants from swivel hangers.
H. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
I. Pole-Mounted Luminaires:
    1. Maintain the following minimum clearances:
        a. Comply with IEEE C2.
        b. Comply with utility company requirements.
    2. Foundation-Mounted Poles:
        a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 3000.
            1) Install anchor bolts plumb per template furnished by pole manufacturer.
            2) Position conduits to enter pole shaft.
        b. Install foundations plumb.
        c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
        d. Tighten anchor bolt nuts to manufacturer's recommended torque.
        e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
        f. Install anchor base covers or anchor bolt covers as indicated.
    3. Embedded Poles: Install poles plumb as indicated.
    4. Grounding:
        a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
        b. Provide supplementary ground rod electrode as specified in Section 26 0526 at each pole bonded to grounding system as indicated.
    5. Install separate service conductors, 10 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
    6. Install non-breakaway in-line fuse holders and fuses complying with Section 26 2813 in pole handhole or transformer base for each ungrounded conductor.
    7. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in *Division 26 05 30* in designated poles.
J. Install accessories furnished with each luminaire.
K. Bond products and metal accessories to branch circuit equipment grounding conductor.
L. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

A. See *Division 01 40 00* - Quality Requirements, for additional requirements.
B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.
D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect/Engineer.
E. Measure illumination levels at night with calibrated meters to verify compliance with performance requirements. Record test results in written report to be included with submittals.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect/Engineer. Secure locking fittings in place.
B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect/Engineer.

3.06 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See *Division 01 79 00* - Closeout Submittals, for closeout submittals.
B. See *Division 01 80 00* - Demonstration and Training, for additional requirements.
C. Demonstration: Demonstrate proper operation of luminaires to Architect/Engineer, and correct deficiencies or make adjustments as directed.
D. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

DIVISION 27 05 00 – TELECOMMUNICATIONS

GENERAL

TELEPHONE/ DATA SYSTEMS

Designer shall coordinate with MSCS Information Technology department all requirements and standards for telephone and data systems. When applicable, allowances for telephone and data systems will be acquired for inclusion into the contract documents specific to the project.

All exposed Telephone/Data wiring to be installed in conduit

INTERCOM/ PUBLIC ADDRESS SYSTEMS

Designer shall coordinate with MSCS Information Technology department all requirements and standards for intercom and public address systems. When applicable, allowances for intercom and public address systems will be acquired for inclusion into the contract documents specific to the project.

All exposed Intercom/Data wiring to be installed in conduit.

DIVISION 27 05 20 – GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Grounding/Earthing and bonding for Low Voltage systems such as telecommunications and audiovisual systems.
2. Primary Bonding Busbar (PBB)
3. Secondary Bonding Busbar (SBB)
4. Telecommunications Bonding Backbone (TBB)
5. Backbone Bonding Conductor (BBC)
6. Rack Bonding Busbar (RBB)
7. Telecommunications Equipment Bonding Conductor (TEBC)
8. Telecommunications bonding conductor (TBC)
9. Pathways.

B. Related Sections:
   1. Division 26 Section Grounding and Bonding for building systems with which to interface with Work of this Section.

1.02 DEFINITIONS

A. AFC: Above Finished Ceiling
B. BICSI: Building Industry Consulting Service International.
C. Bonding: Permanent joining of metallic parts to form an electrically conductive path to ensure electrical continuity and capacity to safely conduct current.
D. Common Bonding Network (CBN) – The principal means for affecting bonding and earthing inside a building.
E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
F. EMI: Electromagnetic interference.
G. Ground/Earth – A conducting connection, whether intentional or incidental, by which an electric circuit or equipment is connected to ground, or to some conducting body of relatively large extent that serves in place of the ground.
H. HC: Horizontal Cross Connect
I. IDC: Insulation displacement connector.
J. LAN: Local Area Network.
K. MC: Main Cross-connect
L. NEBS: Network Equipment Building System.
   1. NEBS Level 3: Equipment complies with strict specifications for fire suppression, thermal margin testing, vibration resistance including seismic, airflow patterns, acoustic limits, failover and partial operational requirements such as chassis fan failures, failure severity levels, RF emissions and tolerances, and testing/certification requirements.
M. NEC: National Electric Code
N. RCDD: Registered Communications Distribution Designer.
O. TR: Telecommunications Room
P. UTP: Unshielded twisted pair.

1.03 SYSTEM DESCRIPTION

A. Provide a complete and functioning Telecommunications grounding/earthing system inclusive of all hardware, software and training to meet or exceed the performance features outlined in this document.
B. Purpose: Telecommunications grounding/earthing system creates a low impedance path to earth ground to prevent damage to equipment and disruption in service due to electrical surges and transient voltages.
C. Grounding/earthing system comply with following:
   1. NEC and local electrical codes
   2. ANSI/TIA-607-D or latest version.
   3. ISO/IEC 30129
   4. IEEE 1100
D. Secondary Bonding Busbar (SBB): Ground/earth each telecommunications space to the Primary Bonding Busbar (PBB) located at the telecommunications entrance room.

1.04 SUBMITTALS

A. Comply with *Division 01 30 00* Section Submittal Procedures.
B. Submittal data is to be submitted electronically. Each submittal shall contain the below in the following order:
   1. Cover Sheet.
      a. Include name of supplying contractor and project name.
   2. Detailed Bill of Materials.
      a. Include a listing of: component quantities, equipment manufacturer, model number, and description of each component being supplied, and the specification paragraph or drawing sheet that corresponds to the product. Failure to provide this information will result in the rejection of submittals.
   3. Product Data.
      a. Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials,

in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product. Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures. If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight.

C. Shop Drawings
   1. Wiring diagram to show grounding schematics, including the following: Busbars and bonding backbone. Detail mounting assemblies and show elevations and physical relationship between the installed components.
   2. Show the relationship of TR's, the pathway between them, and cable connectivity to be installed.
   3. Drawings should be at project standard scale clearly legible.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements, grounding/earthing and bonding systems:
   1. TIA/EIA
      a. TIA-942 Telecommunications Infrastructure Standard for Data Centers
      b. J-STD-607-D Commercial Building Grounding/Bonding Requirements
      c. TIA/EIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
   2. IEEE
      a. Std 1100 IEEE Recommend Practice for Powering and Grounding Electronic Equipment (IEEE Emerald Book)
   3. Telcordia:
      a. NEBS 3 as defined for RBOC-CO compliance.
   4. NFPA
      a. NFPA-70 National Electric Code (NEC)

B. Testing Procedures:
   1. Network Equipment-Building System Requirements: Physical Protection.
   2. Electromagnetic Compatibility and Electrical Safety -- Generic Criteria for Network Telecommunications Equipment

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers, Grounding/Earthing Systems:
   1. Panduit
   2. Chatsworth
   3. Harger
   4. Burndy
   5. Ortronics/Legrand
   6. Erico

B. Acceptable Manufacturers, Telecommunications Bonding Busbars:
   1. Panduit
   2. Chatsworth
   3. Harger
   4. Burndy
   5. Ortronics/Legrand
   6. Erico

C. Acceptable Manufacturers, Rack Bonding Kits:
   1. Panduit
   2. Chatsworth
   3. Harger
   4. Burndy
   5. Ortronics/Legrand
   6. Erico

2.02 GROUNDING/EARTHING AND BONDING

A. General:
   1. Conductors: Provide copper grounding/earthing conductors.
   2. Lugs, grounding strips, and busbars: UL Listed.
   3. Fabricate with premium quality tin-plated electrolytic copper, providing low electrical resistance while inhibiting corrosion.
   4. Provide antioxidant for field- bonding connections.
   5. Lugs: NEBS Level 3. Provide two-hole lugs with irreversible compression and inspection windows, certified for use in non-corrosive environments so that connections may be inspected for full conductor insertion.
   6. Die index numbers: Embossed on compression connections to allow crimp inspection.
   7. Cable assemblies: UL Listed and CSA Certified.
      a. Cables: Green or green/yellow.
      b. Jackets: UL Listed, VW-1 flame rated.

B. Telecommunications Bonding Backbone (TBB): A cable used to ground/earth PBB. Connect PBB to SBB; comply with J-STD-607-D guidelines and provide gauge not lighter than the following:

Table 1 – TBB/BBC/TBC conductor size vs length	
TBB Length in Linear meters (feet)	TBB Size (AWG)
Less than 4 (13)	6
4 - 6 (14 - 20)	4
6 - 8 (21 - 26)	3
8 - 10 (27 - 33)	2
10 - 13 (34 - 41)	1
13 - 16 (42 - 52)	1/0
16 - 20 (53 - 66)	2/0
20 - 26 (67-84)	3/0
26 - 32 (85 - 105)	4/0
32 - 38 (106 - 125)	250 kcmil
38 -46 (126 - 150)	300 kcmil
46 - 53 (151 - 175)	350 kcmil
53 - 76 (176 - 250)	500 kcmil
76 - 91 (251 - 300)	600 kcmil
Greater than 91 (301)	750 kcmil

C. Sizing the Telecommunications Bonding Conductor (TBC)
   1. The TBC shall be, as a minimum, the same size as the largest TBB.

D. Sizing the Backbone Bonding Conductor (BBC)
   1. The BBC shall be, as a minimum, the same size as the largest TBB to which it is connected.

E. Structural metal
   1. The bonding conductor from the structural metal to the PBB or SBB shall be sized according to Table 1. Additionally, this conductor should be no smaller than any conductor that comprises the telecommunications bonding backbone system. Bonds to structural metal shall be made using listed exothermic welding, listed compression connections, or listed mechanical connectors and shall be accessible.

F. Telecommunications Equipment Bonding Conductor (TEBC): A cable used from the PBB or SBB to Rack and Rack Bonding Busbar (RBB) – minimum Size 6AWG.

G. Bonding Cable, Typical: For applications other than TBB, TEBC and BBC, provide gauge not lighter than the following:

Table 2- Cable Sizes for Other Grounding/Earthing Applications	
Purpose	Copper Code Cable Size
Aisle grounds (overhead or under floor) of the common bonding network	#2 AWG or larger (1/0 preferred)
Bonding conductor to each PDU or panel board serving the room.	Size per NEC 250.122 & manufacturer recommendations
Bonding conductor to HVAC equipment	6 AWG
Building columns	4 AWG
Cable ladders and trays	6 AWG
Conduit, water pipe, duct	6 AWG

1.01 COMPONENTS, KITS AND HARDWARE

A. Provide BICSI/J-STD-607-D telecommunications Primary Bonding Busbar PBB. Locate PBB at the telecommunications entrance room.

B. Provide BICSI/J-STD-607-D Telecommunications Bonding Conductor (TBC) from the telecommunications entrance room to the AC service entrance. Bonds to AC service entrance shall be made using listed exothermic welding, listed compression connections, or listed mechanical connectors and shall be accessible.

C. Provide BICSI/J-STD-607-D telecommunications Secondary Bonding Busbar (SBB) at typical telecommunications/equipment spaces throughout the building.
   1. Provide additional SBB's as needed for number of termination points within each telecommunications/equipment space or upsize the SBB to a PBB.
   2. Multiple SBB's within a room shall be bonded together with a conductor the same size as the TBB or with splice bars.

D. Provide BICSI/J-STD-607-D telecommunications Rack Bonding Busbar (RBB) at rack and cabinet locations.

E. Provide compression type two-hole lugs for connecting conductors to PBB, SBB and RBB.

PART 3 - EXECUTION

3.01 ROUTING TBB, TBC AND SBB

A. Route the TBB to each SBB in as straight a path as possible. The TBB should be installed as a continuous conductor, avoiding splices where possible. When more than one TBB is used, bond them together on the top floor and every third floor in-between with a conductor known as a Backbone Bonding Conductor (BBC). When sizing the BBC, it must be at least the same size as the largest TBB.

B. Bend The inside bend radius of telecommunications bonding conductors terminated at the primary bonding busbar (PBB) or secondary bonding busbar (SBB) shall have an inside bend radius of 200 mm (8 inch (203.2 mm)). At other locations, bends in the bonding conductors should be limited to the greatest practical inside bend radius with a minimum bend radius of 10 times the bonding conductor diameter recommended. In all cases, the minimum bend radius angle shall be 90° or greater.

C. Avoid routing grounding/earthing conductors in metal conduits. If the grounding/earthing conductor must be routed through a metal conduit, bond each end of the conduit to the grounding/earthing conductor. Use grounding clamps to bond to the conduit and #6 AWG copper conductor to connect the grounding clamp to the TBB.

3.02 RACK GROUNDING/EARTHING

A. Bonding Equipment and Racks: Comply with BICSI/J-STD-607-D.

B. To provide electrical continuity between rack elements, use paint piercing grounding washers where rack sections bolt together, on both sides, under the head of the bolt, and between the nut and rack.

C. Utilize full-length rack ground strips attached to the rear of the side rail with thread-forming screws provided to ensure metal-to-metal contact.

D. Mount an electrostatic discharge (ESD) port kit, directly to the Rack Bonding Busbar. Mount a second electrostatic discharge (ESD) port kit directly to the vertical mounting rail of the rack in the

front at approximately the same height. Use the thread-forming screws provided to form a bond to the rack.

E. When the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. Use the appropriate jumper for the equipment being installed and the thread-forming screws provided in the kit.
F. Do not bond racks or cabinets serially.
G. Bond patch panels to racks using bonding screws.
H. Patch panels for shielded cabling shall be bonded to the telecommunications bonding system in accordance with manufacturer instructions

3.03 TESTING

A. Perform continuity testing measurements of the grounding system with resistance to not exceed 0.1 ohm between:
   1. The PBB and the nearest grounding electrode.
   2. Each SBB and the nearest grounding electrode.
   3. Each SBB and pathway(s), rack(s), cabinet(s), and applicable equipment.

3.04 GROUNDING SYSTEM

A. Communications grounding system: Comply with ANSI/TIA-942 and ANSI/TIA-607-D.
B. Connection to Building ground/earth: Ensure connection is made by a licensed, electrical Installer, including installation and termination of the main bonding conductor to the building service entrance ground.
C. Bond PBB to building steel; ground/earth to electrical service ground. Comply with BICSI TDM Manual and ANSI/TIA-607-D guidelines.
D. Utilize UL listed exothermic two-hole lugs to make connections to the primary bonding busbar (PBB).

DIVISION 27 05 25 – TELECOMMUNICATIONS FLUSH POKE-THRU DEVICE

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Telecommunications cabling poke-thru
B. Related Sections include the following:
   1. Division 09 Sections for Floor Coverings
   2. Division 26 Electrical Sections
   3. Division 27 Telecommunications Systems

1.02 PERFORMANCE REQUIREMENTS

A. General: These poke-thru devices provide the interface between power, communication and audio/ visual (A/V) cabling in an above grade concrete floor and the workstation or activation location where power communication and/or A/V device outlets are required. These poke-thru devices provide recessed device outlets that will not obstruct the floor area.
   1. ADA Compliance: Flush-mounted floor device outlets shall not create tripping hazards.
B. Floor Mounted Connector Assembly: These poke-thru devices provide flush device outlets that will not obstruct the floor area.
C. Labeling: Floor boxes shall bear the “cULus mark” issued by UL for units complying with both US and Canadian Standards.
D. Classification and use.
   1. This poke-thru device shall have been examined and tested by Underwriters Laboratories Inc. to Standard UL514A and/or UL514C and Canadian Standard C22.2, No. 18-98 and bear the U.S. and Canadian UL Listing Mark. This poke-thru device shall also have been tested by Underwriters Laboratories Inc. and classified for fire resistance and bear the U.S. and Canadian UL Classification Mark. Devices shall be classified for use in 1-, 1 1/2-, or 2- hour rated, unprotected reinforced concrete floors and 1-, 1 1/2-, or 2-hour rated floors employing unprotected steel floor units and concrete toppings (D900 Series Designs) or concrete floors with suspended ceilings (fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling below the poke-thru fittings. This device shall also conform to the standards set in the National Electric Code, Section 300-
      a. 21. These devices meet all UL scrub water requirements, but are not suitable for wet or

damp locations, or other areas subject to saturation with water or other liquids such as commercial kitchens. This poke-thru device shall also have been evaluated by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, terrazzo, wood, and carpet covered floors. Suitable for use in air handling spaces in accordance with Sec 300-22 (C) of the National Electrical Code.

2. Standards: Comply with the following:
3. UL514A and/or UL514C and Canadian Standard C22.2, No. 18-98 and bear the U.S. and Canadian UL Listing Mark
4. National Electrical Code

1.03 SUBMITTALS

A. Related Sections
   1. Comply with requirements of *Division 01 30 00*, "Submittal Procedures."

B. Submittal Data
   1. Submittal data is to be submitted as a complete, single digital file. All documents shall be clearly legible. Each submittal shall contain the below in the following order:
      a. Cover Sheet
         1) Include name of supplying contractor and project name.
         2) Include submittal and revision number.
      b. Detailed Bill of Materials
         1) Include a listing of: component quantities, equipment manufacturers, model numbers, descriptions of each component being supplied, and the specification paragraphs or drawing sheets that correspond to each product.
         2) The bill of materials shall be index referenced within the PDF file so that each product name is clickable, linked to the first page of the corresponding product data.
         3) Failure to provide this information will result in the rejection of submittals.
      c. Product Data
         1) Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product.
         2) Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures.
         3) If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight. All optional components and selections shall be clearly indicated.
      d. Authorized Distributor Certificate
         1) Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is an Authorized Distributor of the product being supplied.
      e. Informational Submittals:
         1) Manufacturer's installation instructions
      f. Submittal shall be a single PDF file.
         1) Partial submittals, or submittals comprised of multiple PDF files, will be rejected.

C. Shop Drawings
   1. Prior to fabrication submit contractor-generated drawings for approval for all supplied systems. These drawings shall include, but are not limited to, the following:
      a. Title Sheet with sheet index and symbols legend
      b. All panels, plates, and designation strips, including connectivity, layout, labeling, and details relating to terminology, engraving, finish and color
      c. All unusual equipment modifications
      d. Equipment location drawings
      e. Floor plans showing poke-thru locations based on column grid lines.
   2. Drawings should be at project standard scale and clearly legible.
   3. Resubmission of contract drawings does not constitute a complete shop drawings submittal

and is unacceptable. Such submittals will be rejected.

D. Form
   1. Submit all materials for review as described above, specifically referenced to the specification paragraph number (where applicable).
      a. Submit all drawings on sheets of one size, preferably the project standard size.
      b. On submittal drawings, maintain 3/32” minimum lettering height. Submittals with text less than 1/16” in height may be rejected.
   2. Product Data and shop drawings must be submitted together in order to be reviewed.

PART 2 - PRODUCTS

2.01 POKE THRU DEVICE

Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:
1. Wiremold, Legrand
2. Hubbell Premise Wiring
3. Approved equal

B. The same manufacturer shall provide all poke-thru types for the project.

2.02 MATERIALS 6AT POKE-THRU ASSEMBLY.

1. 1. This assembly consists of an insert and an activation cover. Overall poke-thru assembly length shall be 16 3/4" 425mm.

B. Insert
   1. The insert body shall recess the devices a minimum of 2 3/4” 2.72 inch (69 mm) and have a polyester based backing enamel finished interior (ivory). There shall be the necessary channels to provide complete separation of power and communication services. There shall be three compartments two side compartment for duplex receptacles that can be wired as a standard receptacle or isolated ground and on center compartment that can accommodate up to eight communication ports.
   2. The body will consist of an intumescent fire stop material to maintain the fire rating of the floor slab. The intumescent material will be held securely in place in the insert body and
      a. shall not have to be adjusted to maintain fire rating of the unit and the floor slab. The insert shall have retaining feature that will hold the poke-thru device in the floor slab without additional fasteners. The poke-thru insert shall also consist of a 3/4" trade size conduit stub that is connected to the insert body and a 24.5 cu. in. 402ml stamped steel junction box for wire splices and connections. The stamped steel junction box shall also contain the necessary means to electrically ground the poke-thru device to the system ground.

C. Activation Cover:
   1. The activation covers shall be manufactured of die-cast aluminum alloy and be available in powder-coated gray, black, or plated in brass, nickel or bronze finish. Two gaskets (one for carpet and one for tile) are provided to go under the trim flange to maintain scrub water tightness. The activation cover shall be 7 1/4" 184mm in diameter. The activation covers shall be available in carpet and tile versions. The carpet covers shall be surface mounted and the tile covers shall be flush with the finished floor covering. The cover shall have spring loaded slides to allow cables to egress out of the unit and maintain as small an egress opening as possible.

D. Communication Modules Mounting Accessories:
   1. The activation shall have one location to mount communication connectors. Connectors shall be mounted using a mounting bracket. Mounting brackets shall be provided to mount up to eight Ortronics TracJack Category 6 insert modules or Category 3. 5e. or 6 keystone connectors. The unit shall also accommodate a mechanism to permit protection of communication cabling. This mechanism shall be stamped steel construction and accept both flexible and rigid conduit. This mechanism shall accept 3/4", 1-1/4" or 2" trade size conduits.

E. Provide pull strings in each conduit at poke thru location.

F. The floor box manufacturer shall have available a complete line of workstation connectivity outlets and modular inserts, and Connectivity Modular Inserts for UTP, Fiber Optic, Coaxial, and

other cabling types with faceplates and bezels to facilitate mounting.

PART 3 - EXECUTION

3.01 EXAMINATION

A. With Installer present, verify that manufacturer's requirements for floor opening and infrastructure conditions have been satisfactorily met. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Arrange for jobsite approval of the equipment prior to commencing installation.
B. Verify exact locations of poke-thru installation.

3.03 INSTALLATION

A. Install equipment in compliance with approved shop drawings and manufacturer's installation instructions.
B. Unit shall permit all wiring to be completed at floor level. The 6AT unit shall mount in a 6" 152mm cored hole, actual 6 1/16" 154mm core hole.
C. Use is defined by the UL Fire Resistance Directory as a minimum spacing of "2 feet (60.96 cm) 610mm on center and not more than one device per each 65 sq. ft. 6m2 of floor area in each span."
D. Installation shall be completed by pushing unit down into the cored hole. Prior to and during installation, refer to system layout and/or approval drawings. Installer shall comply with detailed manufacturer's instruction sheet included with each device. The unit shall contain a retainer for securing the device in the slab, as well as the necessary intumescent material to seal the cored hole under fire conditions.
E. The trim flange color and texture is to be coordinated with architect.

3.04 COPPER CROSS SECTIONAL AREA

A. The maximum copper cross sectional area for the 6AT outer compartment only is
   1. .0154 sq. in. 9.9 mm2. The maximum copper cross sectional area for the center compartment only is .0387 sq. in. 24.9mm2.

3.05 ADJUSTING

A. Adjust poke-thru for proper operation.

3.06 PROTECTION

A. Protect installed equipment in original undamaged condition until Substantial Completion. Remove and provide new components or units that cannot be repaired to the satisfaction of the Architect.

DIVISION 27 05 30 – MULTIMEDIA CONNECTION WALL BOX

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Multimedia Connection Wall Box
B. Related Sections include the following:
   1. Division 27 Telecommunications Systems, Audiovisual Systems, wiring, connections, and installation of associated conduit infrastructure

1.02 PERFORMANCE REQUIREMENTS

A. General: Wall boxes provide an interface between power and telecommunication cabling in a wall mount flat panel display locations requiring power and/or communication device outlets.
B. Wall Mounted Connector Assembly: Rubber cable pass thru door and cover assembly along with connector mounting panel inserts
C. Labeling: Wall boxes shall bear the "cULus mark" issued by UL for units complying with both US and Canadian Standards.
D. Standards: Comply with the following:
   1. National Electrical Code

1.03 SUBMITTALS

A. Related Sections
   1. Comply with requirements of *Division 01 30 00*, "Submittal Procedures."
B. Submittal Data
   1. Submittal data is to be submitted as a complete, single digital file. All documents shall be

clearly legible. Each submittal shall contain the below in the following order:

a. Cover Sheet
    1) Include name of supplying contractor and project name.
    2) Include submittal and revision number.
b. Detailed Bill of Materials
    1) Include a listing of: component quantities, equipment manufacturers, model numbers, descriptions of each component being supplied, and the specification paragraphs or drawing sheets that correspond to each product.
    2) The bill of materials shall be index referenced within the PDF file so that each product name is clickable, linked to the first page of the corresponding product data.
    3) Failure to provide this information will result in the rejection of submittals.
c. Product Data
    1) Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product.
    2) Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures.
    3) If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight. All optional components and selections shall be clearly indicated.
d. Authorized Distributor Certificate
    1. Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is an Authorized Distributor of the product being supplied.
e. Partial submittals, or submittals comprised of multiple PDF files, will not be accepted.

2. Informational Submittals:
    a. Manufacturer's installation instructions

C. Shop Drawings
1. Prior to fabrication submit contractor-generated drawings for approval for all supplied systems. These drawings shall include, but are not limited to, the following:
    a. Title Sheet with sheet index and symbols legend
    b. All panels, plates, and designation strips, including connectivity, layout, labeling, and details relating to terminology, engraving, finish and color
    c. All unusual equipment modifications
    d. Equipment location drawings
    e. Detailed riser drawing indicating conduit runs and associated (box knockout) cables within
    f. Floor plans showing Wall box locations based on column grid lines
2. Drawings should be at project standard scale and clearly legible.
3. Resubmission of contract drawings does not constitute a complete shop drawings submittal and is unacceptable. Such submittals will be rejected.

D. Form
1. Submit all materials for review as described above, specifically referenced to the specification paragraph number (where applicable).
    a. Submit all drawings on sheets of one size, preferably the project standard size.
    b. On submittal drawings, maintain 3/32" minimum lettering height. Submittals with text less than 1/16" in height may be rejected.
2. Product Data and shop drawings must be submitted together in order to be reviewed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:

1. FSR
2. Approved equal

B. Model PWB-100 Wall Box:
1. Box shall be:
a. Manufactured from 14-gauge steel approved for use in new and renovation construction locations.
b. Polyester based backed enamel finished interior (white).
c. Provided with two (2) independent wiring compartments.
d. Able to work with ½" or 5/8" dry wall.
e. Box to be able to be installed between 16" on center metal or wood studs.
f. Able to accept 2-3/4" x 4-1/2" standard size wall plates.

C. Overall box dimensions shall be as follows: 1. 11" W x 5.25" H x 3.57" D.

2.02 COVER

A. PWB-100-WHT - White Cover.

PART 3 - EXECUTION

3.01 EXAMINATION

A. With Installer present, verify that manufacturer's requirements for wall opening and infrastructure conditions have been satisfactorily met. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Verify exact locations of Wall box installation.

3.03 INSTALLATION

A. Install equipment in compliance with approved shop drawings and manufacturer's installation instructions.

B. Install in position and relationship to adjoining work indicated, securely anchored to supporting structure, sealed and finished, and in a manner, which produces a level box with square, plumb, and straight edges.

C. Telecommunications Cabling Wall box shall have a total of three separate EC with pull string at each box as follows:
1. One 3/4-inch EC from box to circuit panel. (Duplex AC Power)
2. Two 1-1/4 inch (32 mm) EC from box to telecomm cable tray A.F.C. One conduit run to lower Low voltage backbox and one conduit run to the upper Low voltage backbox.

D. Provide pull strings in each conduit at wall box location.

3.04 ADJUSTING

A. Adjust door and cover for proper operation.

3.05 PROTECTION

A. Protect installed equipment in original undamaged condition until Substantial Completion. Remove and provide new components or units that cannot be repaired satisfactorily.

DIVISION 27 10 00 – TELECOMMUNICATIONS STRUCTURED CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

A. Building Industry Consulting Services International (BiCSi),"Telecommunications Distributions Methods Manual," Fifteenth Edition

B. American National Standards Institute/Telecommunications Industry Association (ANSI/TIA) - 568.2-D, "Commercial Building Telecommunications Wiring Standard"

C. ANSI/TIA-569-E, "Commercial Building Standard for Telecommunications Pathways and Spaces"

D. ANSI/TIA-606D, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings"

E. ANSI/TIA-607-D, "Commercial Building Grounding/Bonding Requirements"

F. National Electrical Code (NEC), 2020 - National Fire Protection Agency (NFPA) 70

G. Institute of Electrical and Electronic Engineers (IEEE) 802.3 Carrier Sense Multiple Access with Collision Detection (Ethernet 10/100/1000/10000 BASE-T)

H. Federal Communications Commission (FCC), Title 47, Code of Federal Regulations, Part 68
I. National Institution for Certification in Engineering Technologies (NICET)
J. Audiovisual and Integrated Experience Association (AVIXA).

1.03 SUMMARY

A. Section Includes:
1. UTP cabling
2. Optical fiber cabling
3. Multi-pair copper cable
4. Coaxial cable (radio frequency video)
5. Cable connecting hardware, patch panels, and cross-connects
6. Telecommunications outlet/connectors
7. Cable management system
8. Cabling identification products
9. Backboards
10. Telecommunications equipment racks and cabinets
11. Telecommunications service entrance pathways
12. Grounding and bonding
13. Telecommunications Pathways
14. Telecommunications mounting elements

B. Related Sections:
1. *Division 27 05 20*, “Grounding and Bonding for Communications Systems,“ for voice and data cabling associated with system panels and devices
2. *Division 27 05 25*, “Cable Trays for Communications Systems," for voice and data cabling associated with system panels and devices

C. Bidding Requirements:
1. Bidder shall submit complete detailed proposals with line item cost representation for components and associated installation labor. Lump sum bids will not be accepted.
2. Bidders shall include as part of the bid response the following items:
a. Installation schedule with proposed manpower assignments
b. Resumes for project manager and lead technician for this project
c. BICSI RCDD certificate and registration number
3. Bidders shall review associated architectural, electrical, and telecommunications infrastructure drawings to verify that necessary conduit and floor boxes will be provided by others. Bidders shall understand and coordinate shared infrastructure locations for telecommunications outlets. The Owner will provide no additional infrastructure to support the telecommunications cabling systems Inside Plant (ISP) and Outside Plant (OSP). Any discrepancies with the identified infrastructure to support these systems should be questioned in the form of a request for information (RFI) during the bidding process. Be responsible for any additional infrastructure requirements after receipt of contract for this project. No wiremold or surface mounted raceways shall be approved on this project except where specifically identified in the contract drawings.
4. Unspecified Equipment and Material: Any item of equipment or material not specifically addressed on the drawings or in this document and required to provide a complete and functional Structured Cabling System shall be provided in a level of quality consistent with other specified items.

1.04 DEFINITIONS

A. AFC: Above Finished Ceiling
B. BICSI: Building Industry Consulting Service International
C. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways
D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection
E. EF: Entrance Facility
F. EMI: Electromagnetic interference
G. HC: Horizontal Cross Connect
H. IDC: Insulation displacement connector

I. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs)
J. LAN: Local Area Network
K. MC: Main Cross-connect
L. MPTL: Modular Plug Terminated Link
M. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors
N. NRTL: Nationally Recognized Testing Laboratory
O. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates
P. RCDD: Registered Communications Distribution Designer
Q. TR: Telecommunications Room

1.05 SYSTEM DESCRIPTION

A. Provide a complete and functioning Structured Cabling System inclusive of all hardware, software, and training to meet or exceed the performance features outlined in this document.
B. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
    1. requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
    2. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
    3. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
    4. Bridged taps and splices shall not be installed in the horizontal cabling.
    5. Splitters shall not be installed as part of the optical fiber cabling.
C. The maximum allowable horizontal cable length is 295 feet (8991.6 cm). This maximum allowable length does not include an allowance for the length of 16 feet (487.68 cm) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.
D. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
E. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.
F. Communications equipment room shall provide the space to house the equipment for the backbone and horizontal cabling.

1.06 PERFORMANCE REQUIREMENTS:

A. General Performance: The cabling system shall comply with transmission standards in ANSI/TIA-568.2-D and ANSI/TIA-568.3-D when tested according to the test procedures of this standard.

1.07 SUBMITTALS

A. Comply with requirements of *Division 01 30 00*, “Submittal Procedures.”
B. Submittal Data
    1. Submittal data is to be submitted as a complete, single digital file. All documents shall be clearly legible. Each submittal shall contain the below in the following order:
        a. Cover Sheet
            1) Include name of supplying contractor and project name.
            2) Include submittal and revision number.
        b. Detailed Bill of Materials
            1) Include a listing of component quantities, equipment manufacturers, model numbers, and descriptions of each component being supplied and the specification paragraphs or drawing sheets that correspond to each product.

2) The bill of materials shall include page numbers for each product data sheet and be index referenced within the PDF file so that each product name is clickable, linked to the first page of the corresponding product data.
3) Failure to provide this information will result in the rejection of submittals.

c. Product Data
1) Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet
(a) shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product.
2) Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures.
3) If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight.

d. Authorized Distributor Certificate
1) Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is an Authorized Distributor of the product being supplied.

e. Prequalification Warrantee
1) Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is Authorized to obtain for the owner the Special Warranty for Cabling System and the Special Warranty for System Assurance.

f. Prequalification Certificate
1) Copy of the installing technician(s) certificate of completion from the manufacturer's training school for the equipment being provided.

g. Submittal shall be a single PDF file.
1) Partial submittals, or submittals comprised of multiple PDF files, will be rejected.

C. Shop Drawings
1. Prior to fabrication submit contractor-generated drawings for approval for all supplied systems. Each shop drawing set is to include the below in the following order:
a. Title Sheet
1) Include a list of all drawings in the set and a symbols legend defining each symbol used in the package.

b. Riser Diagram
1) Show the relationship of TR's, the pathway between them, and cable connectivity to be installed.

c. Video/CATV System Engineering
1) Depict device location by room number and device type. Delineate cable types and cable pathway for both riser and horizontal distribution. Calculate db loss and outline levels for each splitter, tap, amplifier, and outlet.

d. Telecommunications Room Details
1) Plan Details of infrastructure and room fittings with clearances
2) Elevation Details of wall fields and rack details showing the relationship of rack mounted elements inclusive of owner-provided equipment (labeled as such).

e. Typical Outlet Details
1) Detail each typical outlet type to be installed. Include manufacturer specific plates, jacks, and an example of labeling. Note on the drawing the typical application of each outlet type, for example; standard office, computer lab, ceiling mounted wireless access location, etc.

f. Floor Plans
1) Show planned location for all elements and cable routing.
2) Include outlet port numbers for each outlet.
3) Cable Schedule: Listing incoming and outgoing cables and their designations, origins, and destinations.

2. Drawings should be at project standard scale and clearly legible.

3. Resubmission of contract drawings does not constitute a complete shop drawings submittal and is unacceptable. Such submittals will be rejected.

D. Product data and shop drawings must be submitted together in order to be reviewed.
E. Samples shall be submitted for each typical outlet type to be installed, complete with colored jacks, finished faceplates, and sample labeling.
F. Field quality-control reports
   1. Submit copy of project status reporting form.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.
   1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
   2. Installation Supervision: Installation shall be under the direct supervision of Level 2 installer and manufactures certified installer, who shall be present at all times when work of this section is performed at project site. At a minimum, one half of remainder of the crew shall be registered technicians by the specified manufacturer as part of their Certified Installer Program.
B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less
   2. Smoke-Developed Index: 50 or less
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
D. Installing company shall be certified by manufactures in aspects of design, installation and testing of optical and Category rated metallic premise distribution systems, be a manufactures Value Added Reseller (VAR) in good standing, have a minimum of five (5) years' experience on similar Structured Cabling Systems (SCS), and have a Registered Communications Distribution Designer (RCDD) on staff.
E. Telecommunications Pathways and Spaces: Comply with ANSI/TIA-569-E.
F. Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, 2017 ANSI/ANSI/TIA–606-C.
G. Grounding: Comply with ANSI-J-STD-607-C.
H. NFPA 70 – National Electric Code, latest edition
I. BICSI – Telecommunications Distribution Methods Manual, Fourteenth Edition
J. NEMA – VE-1 – Metal Cable Tray Systems, 2017
K. NEMA – VE-2 – Metal Cable Tray Installation Guidelines, 2013

1.09 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
   1. Test optical fiber cable to determine the continuity of the strand end to end. Use an optical loss test set.
   2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
   3. Test each pair of UTP cable for open and short circuits.
B. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
B. Environmental Limitations: Do not deliver or install equipment frames and ladder racking until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.11 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
   1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
   2. Record agreements reached in meetings and distribute them to other participants.
   3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
   4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

B. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

C. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

1.12 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Patch-Panel Units: The greater of one (1) or 10% of total quantity of each type
   2. Connecting Blocks: The greater of one (1) or 10% of total quantity of each type
   3. Device Plates: The greater of ten (10) or 2% of total quantity of each type

1.13 WARRANTY

A. Special Warranty for Cabling System: Manufactures warranty shall ensure against product defects; that approved cabling components exceed the specifications of ANSI/TIA-568.2-D, ANSI/TIA-568.3-D, and ISO/IEC IS 11801; exceed the attenuation and NEXT requirements of ANSI/TIA-TSB-67 and ISO/IEC IS 11801 for cabling links/channels; and that the installation will exceed the loss and bandwidth requirements of ANSI/TIA-TSB-67 and ISO/IEC IS 11801 for fiber links/channels. The warranty shall apply to passive SCS components.
   1. Warranty Period: 25 - year Cabling System from date of Substantial Completion

B. Special Warranty for System Assurance: Manufactures warranty shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional application(s) introduced in the future by recognized standards or user forums that recognize ANSI/TIA-568.2-D, ANSI/TIA-568.3-D, or ISO/IEC IS 11801 component and link/channel specifications for cabling.
   1. Warranty Period: 25 - year Applications Assurance from date of Substantial Completion

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PATHWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, and are limited to, the following:
   1. Basis of design: nVent Caddy
   2. Approved equals by:
      a. Eaton/B-line
      b. Hilti Inc.

B. General Requirements: Comply with ANSI/TIA-569-E.

C. Cable Support: NRTL labeled. Cable support brackets in Telecommunications Rooms shall be designed to prevent degradation of cable performance and pinch points that could damage cable.
D. Provide bend limiters, if not built into the cable support, to maintain cable type bend radius whenever cable exists pathways or makes transition between two pathways.
E. Non-continuous cable supports shall be used in any area above the finished ceiling where cable tray is not available.
F. Adjustable non-continuous cable support slings shall be used in corridors as outlined on the TA series drawings.
G. Bridle rings shall not be used for telecom cable support.
H. Non-continuous cable supports
    1. Cable Support shall be NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
    2. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.
    3. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
    4. Non-continuous cable supports sized 1 5/16” and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
    5. Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.
    6. Non-continuous cable supports shall be NVent CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CMTM Double J-Hook CAT100CM; CAT-CMTM U-hook series CAT200CMLN, CAT300CMLN; and CAT-CMTM retainer CATRT200CM, CATRT300CM, or approved equal.
I. Adjustable non-continuous cable support sling
    1. Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable; cULus Listed.
    2. Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.
    3. Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.
    4. If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.
    5. Acceptable products: NVENT CADDY CableCatTM CAT425 or approved equal.
J. Multi-tiered non-continuous cable support assemblies
    1. Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; cULus Listed.
    2. If required, the multi-tier support bracket may be assembled to manufacturer recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.
    3. The multi-tiered support bracket shall consist of NVENT CADDY CATHBA and CableCatTM J-Hooks with screws or approved equal.
K. Non-continuous cable support assemblies from drop wire/ceiling
    1. Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
    2. Acceptable products: NVENT CADDY CAT124Z34, CAT126Z34, CAT214Z34, CAT216Z34, CAT324Z34 or CAT326Z34, or approved equal.
L. Non-continuous cable support assemblies from beam, flange
    1. Fastener to beam or flange with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
    2. Acceptable products: NVENT CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY beam clamps and CADDY flange clips, or approved equal.

M. Non-continuous cable support assemblies from C & Z Purlin
    1. Fastener to C or Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus listed.
    2. Acceptable products: NVENT CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY Purlin hangers, or approved equal.
N. Non-continuous cable support assemblies from wall, concrete, or joist
    1. Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus listed.
    2. Acceptable products: NVENT CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64, with CADDY angle bracket, or approved equal.
O. Non-continuous cable support assemblies from threaded rod
    1. Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.
    2. The multi-tiered support bracket shall have a static load limit of 300 lbs.
    3. U-hooks and Double J-hook shall attach directly to threaded rod using standard nuts.
    4. Acceptable products: NVENT CableCatTM J-hook, CAT12, CAT21, CAT32, CAT64 with CADDY CATHBA series; CAT-CMTM Double J-hook CAT100CM, CAT-CMTM Direct mount U-hook CAT200CMLN, CAT300CMLN; or AFAB series, or approved equal.
P. Raised floor non-continuous cable support assemblies
    1. Fastener to raised (access) floor pedestal with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments; cULus Listed.
    2. products: NVENT CADDY CAT12CD1B, CAT21CD1B or CAT32CD1B; CAT64CD1B, or approved equal.
Q. Cantilever-Mounted cable supports
    1. U-hook shall be able to be assembled to a wide variety of wall mount brackets.
    2. Individual U-hooks shall be spaced as needed, maximum 5’ apart.
    3. U-hooks may have the optional attachment of a cable roller for ease in pulling cables.
    4. Acceptable products: NVENT CAT-CMTM U-hooks CAT200CMLN, CAT300CMLN: CAT-CM roller assemblies CATRL200CM, CATRL300CM; CATWMCM bracket, or approved equal.

2.03 CONDUIT AND BOXES

A. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceways and Boxes." Flexible metal conduit shall not be used.
    1. Outlet boxes shall be no smaller than 5 inches (127 mm) wide, 5 inches high, and 2.875 inches deep.

2.04 UTP CABLE

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:
    1. Berk-Tek - Leviton
    2. CommScope, Inc.
    3. Mohawk; a division of Belden CDT
    4. Superior Essex Inc.
    5. SYSTIMAX Solutions; a CommScope, Inc. brand
    6. Uniprise; a CommScope, Inc. brand
    7. Hubbell Premise wire
    8. General Cable Technologies Corporation
    9. Belden, Inc.
    10. Hitachi Cable America Inc.
B. Description: 100-ohm, 4-pair UTP, covered with a blue thermoplastic jacket
    1. Comply with ANSI/TIA-568.2-D for performance specifications.
    2. Comply with ANSI/TIA-568.2-D, Category 6A.
    3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with and NFPA 70 for the following types:
        a. Communications, Plenum Rated: Type CMP, complying with NFPA 262

2.05 UTP CABLES - WIRELESS ACCESS POINT

A. Manufacturers: Subject to compliance with requirements, provide cable product by the specified UTP cable manufacturer article “UTP CABLE”.

B. Description: 100-ohm, 4-pair UTP, covered with a blue thermoplastic jacket
   1. Comply with ANSI/TIA-568.2-D for performance specifications.
   2. Comply with ANSI/TIA-568.2-D, Category 6A.
   3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with and NFPA 70 for the following types:
      a. Communications, Plenum Rated: Type CMP, complying with NFPA 262

2.06 UTP CABLES WET LOCATIONS OR SLAB ON GRADE

A. Manufacturers: Subject to compliance with requirements, provide cable product by the specified UTP cable manufacturer article “UTP CABLE”.

B. Description: 100-ohm, 4-pair UTP, covered with a thermoplastic jacket.
   1. Match color in article “UTP CABLE”.
   2. Comply with ICEA S-90-661 for mechanical properties.
   3. Comply with ANSI/TIA-568.2-D for performance specifications.
   4. Specifically designed for below-grade conduit or other environments where water is likely to infiltrate.
   5. UL Verified for long term water submersion.
   6. Comply with ANSI/TIA-568.2-D, Category 6A.
   7. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with NFPA 70 for the following types:
      a. Communications, Plenum Rated: Type CMP, complying with NFPA 262

2.07 UTP CABLE HARDWARE

A. Manufacturers Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:
   1. Hubbell Premise Wiring
   2. Leviton Voice & Data Division
   3. SYSTIMAX Solutions; a CommScope, Inc. brand
   4. Uniprise, a CommScope, Inc. brand
   5. Panduit Corp.
   6. Siemon Co. (The)
   7. Ortronics Corp.
   8. Belden, Inc.
   9. Hellermann Tyton

B. General Requirements for Cable Connecting Hardware: Comply with ANSI/TIA-568-D, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables

D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables. All patch panels shall be 48-port.
   1. Number of Jacks per Field: Provide one for each four-pair UTP cable indicated conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

E. Jacks and Jack Assemblies: Modular, color-coded, eight-position, eight conductor, modular receptacle units with integral IDC-type terminals.
   1. Comply with ANSI/TIA-568.2-D, Category 6A.

2.08 UTP CABLE HARDWARE - WIRELESS ACCESS POINT

A. Manufacturers: Subject to compliance with requirements, provide cable product by the specified UTP cable manufacturer article “UTP CABLE HARDWARE”.

B. General Requirements for Cable Connecting Hardware: Comply with ANSI/TIA-568-D, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables. All patch panels shall be 48-port.
   1. Number of Jacks per Field: Provide one for each four-pair UTP cable indicated conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
D. Jacks and Jack Assemblies: Modular, color-coded, eight-position, eight conductor, modular receptacle units with integral IDC-type terminals.
   1. Comply with ANSI/TIA-568.2-D, Category 6A.

2.09 PATCH CORDS

A. Patch Cords: Factory-made, four-pair cables in 3'-20' in length; terminated with eight-position modular plug at each end. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure specified category performance. Patch cords shall have latch guards to protect against snagging.
   1. TR location: Provide one (1) patch cord to match cable and Jack Assembly category rating per port on the patch panel.
   2. Floor outlet locations: Provide one (1) ten foot modular patch cord to match cable and Jack Assembly category rating per eight-position eight conductor modular receptacle.

2.10 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks and Jack Assemblies: Modular, color-coded, eight-position, eight conductor, modular receptacle units with integral IDC-type terminals.
   1. Comply with ANSI/TIA-568.2-D, Category 6A.
B. Workstation Outlets: Provide connector assemblies mounted in single or multigang faceplates as shown on contract drawings.
C. Provide faceplate types to match Division 26 section, "Wiring Devices."
   1. Plastic Faceplate: High-impact plastic, complying with color requirements in Division 26 Section "Wiring Devices"
   2. Metal Faceplate: Stainless steel, complying with requirements in Division 26 Section "Wiring Devices"
   3. Wall phone Metal Faceplate: Stainless steel, w/ Studs for Wall Mount Phone outlet.
   4. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords
   5. Legend: Factory labeled by silk-screening or engraving
   6. Legend: Machine printed, in the field, using adhesive-tape label
   7. Legend: Snap-in, clear-label covers and machine-printed paper inserts

2.11 TELECOMMUNICATIONS OUTLET/CONNECTORS- WIRELESS ACCESS POINT

A. Jacks and Jack Assemblies: Modular, color-coded, eight-position, eight conductor, modular receptacle units with integral IDC-type terminals.
   1. Comply with ANSI/TIA-568.2-D, Category 6A.
B. Workstation Outlets: Provide connector assemblies in two port surface mount box.
   1. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords
   2. Legend: Snap-in, clear-label covers and machine-printed paper inserts

2.12 RISER COPPER CABLE

A. Description: 100-ohm, 25-pair UTP, formed into 25-pair binder groups covered with a thermoplastic jacket Comply with ICEA S-90-661 for mechanical properties.
   1. Comply with ANSI/TIA-568.2-D for performance specifications.
   2. Comply with ANSI/TIA-568.2-D, Category 5e.
   3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with and NFPA 70 for the following types:
      a. Communications, Plenum Rated: Type CMP, complying with NFPA 262

2.13 RISER UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by the specified structured cabling solution manufacturer.
B. General Requirements for Cable Connecting Hardware: Comply with ANSI/TIA-568.2-D, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with

connecting hardware of the same category or higher.

C. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

D. Patch Panel: IDC-type for permanent termination of pair groups of installed cables. All patch panels shall be 48 - port.
   1. Terminate riser cable one pair per port on the patch panel.

E. Patch Cords: Factory-made, four-pair cables, 3'-20' in length; terminated with eight-position modular plugs at each end. Patch cords shall have bend-relief-compliant boots and color-coded icons to guarantee the specified category performance. Patch cords shall have latch guards to protect against snagging.
   1. TR location: Provide one (1) patch cord per port on the patch panel to match the cable and jack assembly category rating.

2.14 RUS PE89 COPPER CABLE

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
   1. Superior Essex Inc.
   2. SYSTIMAX Solutions; a CommScope Inc. brand
   3. General Cable Technologies Corporation
   4. Uniprise; a CommScope, Inc. brand
   5. Approved equal

B. Description: 100-ohm, 25-pair 24 AWG PE89, formed into 25-pair binder groups covered with a Black polyethylene jacket
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with ANSI/TIA-568.2-D for performance specifications.
   3. Comply with ANSI/TIA-568.2-D, Category 3.

2.15 OUTSIDE PLANT CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by the specified structured cabling solution manufacturer.

B. General Requirements for Cable Connecting Hardware: Comply with ANSI/TIA-568.2-D, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 3. Provide blocks for the number of cables terminated on the block, plus 25% percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables

2.16 COPPER CABLE PROTECTION UNITS

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
   1. Commscope
   2. Cira Telecom
   3. Tii Technologies Inc.
   4. Approved equal

B. Provide all copper circuits with protection between each building with an entrance cable protector panel.
   1. All building-to-building circuits shall be routed through this protector.
   2. The protector shall be connected with a #6 AWG copper bonding conductor between the protector ground lug and the EF ground point.
   3. The installation shall employ three-element solid state protector modules.

2.17 COPPER SPLICE CASE

A. Copper splice cases as required for OSP splices and transition splice in TR/MC/EF sized to fit splice quantities. Manufactured by Preformed Line Products, 3M or approved equal.

B. Copper splice will be performed in Maintenance Holes only.

C. Splice case filling compound, re-enterable type: 3M 4442 or approved equal

D. Heat Shrink Tubing: Highly Flame Resistant, semi rigid polyvinylidene fluoride (Kynar)

2.18 COAXIAL CABLE

A. Manufacturers: Subject to compliance with the specified requirements, provide products by the following:
   1. CommScope, Inc.
   2. Mohawk; a division of Belden CDT

B. Horizontal Cable Characteristics: Broadband type, recommended by the cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 1004 MHz.
   1. RG-6/ U
      a. Communications, Plenum Rated: Type CMP, complying with NFPA 262
         1) No. 18 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation
      b. Quad shielded with 100 percent aluminum-foil shield and 60 braid, non-bonded tape, 40% Braid, Copolymer jacket
      c. Suitable for indoor installations

C. Riser/Backbone Coaxial Cable: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 1004 MHz.
   1. 500/ U
      a. Communications, Plenum Rated: Type CMP, complying with NFPA 262
         1) Gauge: 12 AWG solid bare copper, (.500 inch (12.7 mm))
      b. Outside Diameter: 0.648 inch (16.46 mm)
      c. Shields: Duofoil + 63% tinned copper braid
      d. Insulation: Black tint Teflon jacket
      e. Nominal DC Resistance: 8.2 □/km
      f. Nominal Mutual Capacitance: 53.5 pF/m @ 1 kHz
      g. Attenuation: 0.5 dB/100 m @ 1 MHz
      h. Characteristic Impedance: 75 □ @ 1 MHz

D. Outside Building Backbone Coaxial Cable: Outside-building vertical backbone coaxial cable in the new facility supporting video communications requirements shall meet the following technical specifications:
   1. .750/U
      a. Gauge: 12 AWG solid bare copper, (.750 inch (19.05 mm))
      b. Outside Diameter: 0.948 inch (24.08 mm)
      c. Shields: Duofoil + 63% tinned copper braid
      d. Insulation: Black tint Teflon jacket
      e. Nominal DC Resistance: 8.2 □/km
      f. Nominal Mutual Capacitance: 53.5 pF/m @ 1 kHz
      g. Attenuation: 0.5 dB/100 m @ 1 MHz

2.19 VIDEO SYSTEMS PARTS AND ACCESSORIES

A. Bi-directional Amplifier
   1. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
      a. Blonder Tongue BIDA 5800 series
      b. Toner TIBA 37-1000
      c. Approved equal
         1) Install in the TR/MC and each TR/HC as needed to complete video system adjusting.

B. Splitters and Taps – Install as needed to complete fully functional CATV distribution system as specified.
   1. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
      a. Blonder Tongue SCVS Digital splitters

b. Toner XGVS Digital splitters
c. Blonder Tongue SRT Digital taps
d. Toner TXMT Digital taps
e. Approved equal

C. F style Connectors to match cable type
1. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
a. Aim Electronics; a brand of Emerson Electric Co.
b. Toner Cable Equipment, Inc.
c. Blonder Tongue Inc.
d. Approved equal

D. F-type terminators:
1. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
a. Aim Electronics; a brand of Emerson Electric Co.
b. Toner Cable Equipment, Inc.
c. Blonder Tongue Inc.
d. Approved equal

2.20 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:
1. Superior Essex Inc.
2. CommScope, Inc.
3. Corning Cable Systems
4. General Cable Technologies Corporation
5. Belden, Inc.
6. Mohawk; a division of Belden CDT
7. Optical Cable Corporation
8. Uniprise; a CommScope, Inc. brand
9. SYSTIMAX Solutions; a CommScope Inc. brand
10. Hitachi Cable America Inc.

B. Indoor OM4 Multimode
1. Description: 50/125-micrometer, laser-optimized, 24-strand, nonconductive, tight buffer optical fiber cable
2. Comply with ICEA S-83-596 for mechanical properties.
3. Comply with ANSI/TIA-568.3-D for performance specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1651, and NFPA 70 for the following types:
a. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262
b. Riser Rated, Conductive: Type OFCR, complying with UL 1666
5. Maximum Attenuation: 3.0 dB/km at 850 nm; 1.5 dB/km at 1300 nm
6. Minimum Modal Bandwidth: 3500 MHz-km at 850 nm; 500 MHz-km at 1300 nm
7. Jacket:
a. Jacket Color: Aqua
b. Cable cordage jacket, fiber, unit, and group color shall comply with ANSI/TIA-598-B.
c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1016 mm).

C. Outdoor OM4 Multimode
1. Description: 50/125-micrometer, laser-optimized, 24-strand, nonconductive, ribbon optical fiber cable
2. Comply with the following standards for mechanical properties:
a. Outside plant cable: ICEA S-87-640
b. Indoor/Outdoor cable: ICEA S-104-696

c. Aerial, duct, and buried outdoor cable: ICEA S-110-717
d. Indoor/Outdoor drop applications: ICEA S-110-717
3. Comply with ANSI/TIA-568.3-D for performance specifications.
4. Comply with ANSI/TIA-492AAAA-A for detailed specifications.
5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1651, and NFPA 70 for the following types:
a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262
6. Maximum Attenuation: 3.0 dB/km at 850 nm; 1.5 dB/km at 1300 nm
7. Minimum Modal Bandwidth: 3500 MHz-km at 850 nm; 500 MHz-km at 1300 nm
8. Jacket:
a. Jacket Color: Purple
b. Cable cordage jacket, fiber, unit, and group color shall comply with ANSI/TIA-598-B.
c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1016 mm).
9. Conductive cable shall be steel armored type.
10. Non- conductive cable shall be dielectric armored type.

D. Indoor OS2 Singlemode
1. Description: 12-strand fiber, nonconductive, tight bufferoptical fiber cable
2. Comply with ICEA S-83-596 for mechanical properties.
3. Comply with ANSI/TIA-568.3-D for performance specifications.
4. Comply with ANSI/TIA-492-CAAA for detailed specifications.
5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1651, and NFPA 70 for the following types:
a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262
6. Maximum Attenuation: 0.3 dB/km at 1550 nm
7. Jacket:
a. Jacket Color: Yellow
b. Cable cordage jacket, fiber, unit, and group color shall comply with ANSI/TIA-598-B.
c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1016 mm).
8. Conductive cable shall be steel armored type.
9. Non- conductive cable shall be dielectric armored type.

2.21 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:
1. Hubbell Premise Wiring.
2. Leviton Voice & Data Division.
3. CommScope, Inc.
4. Panduit Corp.
5. Siemon Co. (The)
6. Belden, Inc.
7. Ortronics Corp.
8. Corning Cable Systems
9. Optical Cable Corporation (OCC)
10. Hellermann Tyton

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, simplex and duplex cable connectors
1. Number of Connectors per Field: Provide one for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit the specified expansion criteria.
2. Fiber optic enclosures shall be rack-mountable with accommodations for splice trays.
3. Fiber optic enclosures shall be wall-mountable with accommodations for splice trays.
4. Install fusion splice trays as needed for transition points and factory terminated pigtails.
5. LC duplex 12-fiber coupler panels shall be used for multimode fiber.
6. LC duplex 12-fiber coupler panels shall be used for singlemode fiber.
7. Size fiber enclosure for 25% percent spare capacity.

C. Patch Cords: Provide factory-made, dual-fiber cables in one (1) meter lengths. Supply LC duplex for one-half of the total termination points.
D. Patch Cords: Provide factory-made, dual-fiber cables in three (3) meter lengths. Supply LC duplex for one-half of the total termination points.
E. Cable Connecting Hardware:
    1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of ANSI/TIA-604-2, ANSI/TIA-604-3-A, and ANSI/TIA-604-12. Comply with ANSI/TIA-568.3-D.
    2. Multimode connector type: LC
    3. Singlemode connector type: LC
    4. Connectors for multimode and singlemode shall be field installed via fusion splicing.
F. Wall mounted optical fiber slack loop holder
    1. 48900-IFR
    2. 48900-OFR
        a. Place on wall to manage slack one for each fiber type

2.22 OPTICAL FIBER CABLE SPLICE

A. Fiber splice shall be placed in a cabinet with tray quantities for total fusion splices for transition splice in TR. Manufactured by Corning or approved equal.

2.23 INNERDUCT

A. OSP applications:
    1. Description: Standard Outdoor Textile Innerduct, 3-inch, 3-cell, polyester and nylon resin polymer textile innerduct with factory-installed flat woven pull tape. Manufactured by MaxCell or approved equal.
    2. Fittings:
        a. Conduit Plugs: Use compression-type conduit plugs with locking nuts to seal and secure one or more textile innerducts within 4” conduits.
        b. Termination Bags: Use inflation-type bags to seal and secure one or more textile innerducts within 2” or larger conduit.
B. Indoor applications:
    1. Description: Indoor, Riser-rated, 3-cell, nylon textile innerduct, Orange or White in color, with factory installed pull tape. Manufactured by MaxCell or approved equal.
    2. Fittings:
        a. Conduit Plugs: Use compression-type conduit plugs with locking nuts to seal and secure one or more textile innerducts within 4” conduits.
        b. Termination Bags: Use inflation-type bags to seal and secure one or more textile innerducts within 2” or larger conduit.
C. OSP applications:
    1. Description: Corrugated High Density Polyethylene (HDPE) 1 ¼ inch Orange in color with factory installed pull tape. Manufactured by Carlon or approved equal.
    2. Splices shall only be at Maintenance Hole locations if necessary. No splices shall be allowed in conduit.
    3. Use PIC1 Nonmetallic internal coupling to join sections as needed.
D. Indoor applications:
    1. Description: Plenum-gard 1 ¼ inch Orange or White in color with factory installed pull tape. Manufactured by Carlon or approved equal.
    2. Splices shall only be in SEF or TR/MC/HC locations if necessary. No splices shall be allowed in conduit.
    3. Use manufacturer approved nonmetallic internal coupling to join sections.
    4. Use manufacturer approved nonmetallic internal coupling to join sections.

2.24 CABLE LUBRICANT

A. Cable pulling lubricant shall be utilized when pulling cable.

B. Product:
    1. Ideal
    2. Polywater
    3. or approved equal

2.25 FIRE STOP CABLE PASS-THRU SLEEVES

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:
    1. Basis of design: Specified Technologies Inc.
    2. Approved equal by:
        a. 3M Corporation
        b. Hilti CFS-MSL Modular Sleeve
        c. Hilti Speed Sleeve
        d. Wiremold- Legrand Corporation
B. Fire Rated Cable Pathways: STI EZ-PATH Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill. The following products are acceptable:
    1. Specified Technologies Inc. (STI) EZ-PATH Series 44 Fire Rated Pathway
    2. Specified Technologies Inc. (STI) EZ-PATH Series 33 Fire Rated Pathway
C. EZ-path series 44 wall sleeves shall be provided for all telecom room penetrations to cable distribution system.
D. Horizontal cable pathway locations greater than 20 cables fire stop sleeves shall be STI EZ-Path series 33.
E. Horizontal cable pathway locations fewer than 20 cables EMT sleeve with UL listed system for firestopping is acceptable. Caulks and sealants shall be as manufactured by STI, Hilti, 3M, Nelson, or approved equivalent.
F. Fill ratio for fire stop EMT sleeves shall not exceed 20% fill capacity.

2.26 FIRE STOP CABLE MODULAR FLOOR GRID SYSTEM

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:
    1. Basis of design: Specified Technologies Inc.
    2. Approved equal by:
        a. Hilti Corporation
        b. 3M Corporation
B. Fire stop sleeves located in the floor of TR's shall be STI EZ PATH Series 44 Modular Grid. Provide sleeves for all Telecom Room floor penetrations. Fill ratio shall not exceed 20% fill capacity.
    1. Product: EZDG444 single slot grid complete with EZ-PATH Series 44 modules
    2. Product: EZG844 with EZD444MB pathway modules.
    3. Product: EZG1644 with EZD444MB pathway modules

2.27 NON-RATED CABLE PASS-THRU SLEEVES

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:
    1. Basis of design: Specified Technologies Inc.
    2. Approved equal by:
        a. 3M Corporation
        b. Hilti Smoke and Acoustic Sleeve
        c. Wiremold- Legrand Corporation
B. Non-Rated Cable Pathways: STI EZ-PATH Brand device modules The smoke and acoustical pathway shall contain a built-in sealing system and shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to remove or reinstall acoustical materials. The following products are acceptable:
    1. Specified Technologies Inc. (STI) EZ Path® Series 44 NEZ Smoke and Acoustical Pathway
    2. Specified Technologies Inc. (STI) EZ Path® Series 33 NEZ Smoke and Acoustical Pathway
    3. SpecSeal® Smoke 'N' Sound Smoke and Acoustical Sealant
        a. SNS120W 20 Oz Sausage - 36 cu in (592 ml)
        b. b. SNS129W 730573111529 29 Oz Tube - 52 cu in (858 ml)
        c. SNS105W 730573111543 5 Gallon Pail - 1,155 cu in (19.0 L) (White)

C. Horizontal cable pathway locations fewer than 20 cables EMT sleeve with mineral or ceramic fiber stuffing insulation and smoke/acoustical Sealant.
D. Fill ratio for fire stop EMT sleeves shall not exceed 20% fill capacity.

2.28 GROUNDING

A. Comply with requirements in Division 27 Section "Grounding and Bonding" for grounding conductors and connectors.
B. Comply with ANSI-J-STD-607-C.

2.29 LADDER RACK, SUPPORTS, AND ACCESSORIES

A. Ladder Rack (Universal Cable Runway)
   1. Ladder rack shall be manufactured from 3/8” wide by 1-1/2” high tubular steel with .065” wall thickness.
   2. Ladder rack (side stringers) will be 9’-11½” long. Cross members will be welded in between stringers on 12” centers beginning 5-3/4” from one end so that there are 10 cross members per ladder rack. There will be 10-1/2” of open space in between each cross member.
   3. Ladder rack will be delivered individually boxed, and available in the multiple widths.
   4. Finish shall be epoxy-polyester hybrid powder coat (paint) black in color.
   5. Product: Chatsworths Products, Inc. (CPI), Universal Cable Runway: Part Number 10250-712, Universal Cable Runway, 12” Wide, Black or approved equal
   6. Product: Chatsworths Products, Inc. (CPI), Universal Cable Runway: Part Number 10250-718, Universal Cable Runway, 18” Wide, Black or approved equal
   7. Product: Chatsworths Products, Inc. (CPI), Universal Cable Runway: Part Number 10250-724, Universal Cable Runway, 24” Wide, Black placed in vertical positions or approved equal

B. Ladder Rack Splices
   1. Splice kits will provide a method of mechanically connecting ladder rack sections and turns together end-to-end or side-to-end to form a continuous pathway for cables.
   2. Grounding kits will provide a method of bonding ladder rack sections and turns together that is independent of the pathway splices. The grounding kit should be constructed of UL Listed components. The preferred solution is a #6 AWG green insulated stranded copper conductor connected on both ends to ladder rack using two-hole compression lugs and stainless steel hardware.
   3. Splices (splice plates) will be manufactured from steel. Splice, grounding and insulator bar kits will include installation hardware.
   4. Finish (of splice plates and hardware) shall be zinc plate in the color(s) specified below. Colors are applied as a chem. film over the zinc plate.
   5. Product: Chatsworths Products, Inc. (CPI), Cable Runway Splices or approved equal

C. Ladder Rack Supports
   1. Supports will be sized to match the width of the ladder rack that is supported. Some supports will work with all widths of ladder rack.
   2. Each support will include a means of securing ladder rack to the support.
   3. Supports will be manufactured from steel or aluminum.
   4. Finish shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified below or zinc plate with a gold chem. finish specified gold. Included hardware shall be zinc plated with a gold chem. finish.
   5. Product: Chatsworths Products, Inc. (CPI), Cable Runway Supports or approved equal

D. Ladder Rack Accessories
   1. Cable straps used for attaching cable bundles to the ladder rack cross members must be reusable with a hook and loop-style closure, at least ¾” wide, and sized for cable bundles that are 2”, 3” or 4” in diameter.
   2. Cable retaining posts used to keep cable from falling off of the side of the ladder rack shall be manufactured from 1” by ½” tubular steel with .065” wall thickness. Cable retaining posts will be 8” high and will attach to the side stringer of the ladder rack with included
      a. hardware. The top of the cable retaining posts will be fitted with a rubberized end cap to protect cables.
   3. End caps used to cover the ends of ladder rack will be manufactured from a black fire-retardant rubberized material. End caps will be sized for 3/8” wide by 1-1/2” high side

stingers and will be sold in pairs.

4. End closing kits used to cover the end of ladder rack will be manufactured from 3/8” wide by 1-1/2” high tubular steel with .065” wall thickness. Kits will consist of a bar cut to match the width of the ladder rack and the hardware required to attach the bar to the end of a length of ladder rack.
5. Radius drops used to create a radius to form cables over as the cables exit or enter the ladder rack will be manufactured from aluminum extrusion. The extrusion will be formed in a 90° arc with a minimum bend radius of 3”. Radius drops will attach to either the side stringer or the cross member of the ladder rack using a clevis pin. Radius drops will include 1-1/2” high cable spools that attach to the top of the radius drop to guide cables.
6. Movable cross members used to support cross member radius drops in between welded cross members on ladder rack will be manufactured from 3/8” by 1-1/2” aluminum bar. Movable cross members will attach to ladder rack at the side stringers with included hardware so that the location of the movable cross member can be adjusted. Moveable cross member will support a cross member radius drop.
7. Cable spools used to separate ladder rack into multiple cable pathways will be made from a black flame retardant ABS. Cable spools will attach to the cross members with a clip that allows the width of the ladder rack to be divided into any proportion. The spools will be 3.94” tall, with a 1.94” diameter top, and a body that tapers from .88” (diameter) at the top to .62” (diameter) at the bottom.
8. Auxiliary support brackets used to support cables that should be physically separated from the cables in the ladder rack will be made from 1/8” x 1” steel bar. The bracket will be L-shaped and will attach to the side stringer of the ladder rack. The bracket will hang below the ladder rack a minimum of 4”. The bracket support surface will be 4” long. The bracket will be zinc plated with a gold chem. finish.
9. Touch-up paint used on ladder rack and ladder rack system components will be color-matched to the finish on the ladder rack or component. A spray on and brush on option will be available.
10. Unless otherwise noted, finish on all metal components shall be epoxy-polyester hybrid powder coat (paint) black in color. Hardware will be zinc plated with a gold chem. finish.
11. Product: Chatsworths Products, Inc. (CPI), Cable Runway Accessories or approved equal

2.30 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (2438.4 mm) A-C Grade
   1. Provide materials that comply with performance requirements in AWPA C27. Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
   2. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5516, for plywood.

B. All 4 walls shall be covered with rigidly fixed 3/4 inch (19.05 mm) A-C plywood with the A grade side facing outward. The plywood shall be void free and extend from 6 inches (152.4 mm) above the finished floor (AFF) to 102 inches (2590.8 mm) AFF and capable of supporting the attached equipment.

C. Comply with requirements in Division 09 Section “Paints and Coatings" for fire-retardant plywood.

2.31 EQUIPMENT FRAMES

A. Free Standing Relay Racks
   1. Racks shall be manufactured from aluminum and/or steel extrusions.
   2. Each rack will have two L-shaped top angles, two L-shaped base angles and two C-shaped equipment-mounting channels. The rack will assemble with bolt hardware. Equipment-mounting channels will be threaded for easy assembly. The base angles will be pre-punched for attachment to the floor.
   3. Equipment mounting channels will be 3” deep and punched on the front and rear flange with the EIA-310-D Universal hole pattern to provide 45 rack-mount spaces for equipment. Each mounting space will be marked and numbered on the mounting channel.
   4. When assembled with top and bottom angles, equipment-mounting channels will be

spaced to allow attachment of 19” EIA rack-mount equipment. Attachment points will be threaded with 12-24 roll-formed threads. The rack will include assembly and equipment-mounting hardware. Each rack will include 50 each combination pan head, pilot point mounting screws.

5. The rack will be rated for 1,500 lb. of equipment.
6. The rack will be UL Listed.
7. Finish shall be epoxy-polyester hybrid powder coat black in color.
8. Product: Chatsworths Products, Inc. (CPI), Universal Self-Support Rack or approved equal

2.32 CABLE MANAGEMENT

A. Vertical Cable Management for Racks

1. Every rack will have a minimum of one vertical cable manager. The vertical cable manager will create a space for storing and organizing cables along the side of the rack/frame. The cable manager will maintain separation between patch/equipment/jumper cords and premise cables. The last rack in a row shall have two vertical cable managers.
2. The cable manager will be sized to match cabling requirements and to fit the rack/frame or as specified. The initial quantity of cables within the cable manager will not exceed a whole number value equal to 40% of the interior area of the cable manager.
3. A single vertical cable manager can be used in between bayed racks/frames if it is sized to match cable requirements for both racks/frames. The manufacturer will state estimated cable fills for the cable manager in the product data sheet.
4. The vertical cable manager will match the height of the rack(s)/frame(s).
5. The vertical cable manager will bolt to the side of racks/frames with included hardware. The manufacturer of the vertical cable manager will sell compatible racks/frames.
6. The vertical cable manager will be a double-sided H-shaped trough with front and rear covers. The double-sided trough will provide independent front and rear cable pathways and will have multiple evenly-spaced edge-protected front-to-rear cable pass-through holes for cables in the center divider.
7. The front and rear covers will be removable, hinged to open from the right or left side and will include a latch that will secure the cover in the closed position.
8. The vertical cable manager will have cable openings along both sides of the trough. The openings will be formed by evenly-spaced T-shaped cable guides. The T-shaped cable guides will be made from a composite plastic material (not metal) and will have rounded edges to protect cables. When the cable manager is attached to a rack/frame, each cable opening will align with a rack-mount space (RMU) on the rack/frame. Each opening will pass a minimum of 24 each .25” OD patch cords.
9. The cable manager will be delivered individually boxed, and available in several widths as specified below and in the contract documents.
10. The vertical cable manager shall be manufactured from sheet aluminum and composite materials.
11. Finish shall be epoxy-polyester hybrid powder coat paint in the color as specified below and in the contract documents. Edge-protectors, T-shaped cable guides and latch hardware is black.
12. Product: Chatsworths Products, Inc. (CPI): CCS MCS Master Cabling Section: Part Number Part Number 30095-703, MCS Master Cabling Section, Double-Sided, 6” Wide x 84” High x 16.15”D, Black or approved equal
13. Product: Chatsworths Products, Inc. (CPI): CCS MCS Master Cabling Section: Part Number Part Number 30096-703, MCS Master Cabling Section, Double-Sided, 10” Wide x 84” High x 16.15”D, Black or approved equal

B. Horizontal Cable Management for Racks, Frames or Cabinets

1. Place horizontal cable managers above and below each patch panel in each rack/cabinet. The horizontal cable manager will guide patch/equipment cords between the vertical cable manager and individual network port connections.
2. Provide 2 RMU of horizontal cable management above and below every patch panel. Cables must be able to access the cable manager so that no ports are blocked by the cables.
3. The manufacturer will state estimated cable fills for the cable manager in the product data sheet.

4. The horizontal cable manager will match the rack-mount width of the racks/cabinets.
5. The horizontal cable manager will attach to the front or rear of the rack/frame/cabinet with screws and will be sized to fit within standard EIA-310-D (1-3/4" high RMU) rack-mount spacing. The manufacturer of the horizontal cable manager will sell compatible racks/cabinets.
6. The horizontal cable manager will be a single-sided C-shaped trough with a cover. The single-sided trough will have a slot or holes at the rear to facilitate front-to-rear cabling through the horizontal manager. The front of the cable manager will have T-shaped cable guides along the top and bottom surfaces of the cable manager. Evenly spaced cable openings in between the T-shaped cable guides will allow cables to enter/exit the cable manager into the rack-mount space. The openings will have rounded edges to protect cables. The cover will be removable, hinged to open up or down and will snap on to secure the cover in the closed position.
7. The horizontal cable manager will be delivered individually boxed, and available in several widths and heights as specified below and in the contract documents.
8. The horizontal cable manager shall be manufactured from sheet aluminum and composite materials.
9. Finish shall be epoxy-polyester hybrid powder coat paint in the color as specified below and in the contract documents. Edge-protectors, T-shaped cable guides and latch hardware is black.
10. Product: Chatsworths Products, Inc. (CPI), Universal Horizontal Cable Manager: Part Number 30130-719, Universal Horizontal Cable Manager, Single-Sided, 19" Wide x 2 RMU x 5" Deep, Black or approved equal
11. Product: Chatsworths Products, Inc. (CPI), Universal Horizontal Cable Manager: Part Number 30139-719, Universal Horizontal Cable Manager, Single-Sided, 19" Wide x 1 RMU x 5" Deep, Black or approved equal

2.33 POWER DISTRIBUTION UNIT (PDU)

A. Vertical
   1. Product Feature:
      a. Monitoring Power - Local (Amps, Volts, Watts, Power Factor)
      b. Digital RMS Scrolling Power Meter +/- 2% Accuracy with Full Scale 60Hz sine wave input.
      c. Voltage 100-120V, Current 20A
      d. On/off switch
      e. Power Cable Length 10ft
      f. Plug Type NEMA 5-20P
      g. Receptacle Type NEMA 5-20R - twenty (20) each
      h. Heavy Steel - Powder Coat Finish Black
      i. Configuration - 66in Vertical Rack/Cabinet mount

2.34 UNINTERRUPTIBLE POWER SUPPLY

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:
   1. Chatsworths Products, Inc. (CPI)
   2. MinuteMan
   3. TrippLite
   4. American Power Company (APC)
   5. Cyber Power
   6. Approved equal

B. Each equipment rack shall contain a rack mounted local uninterruptible power supply (UPS).

C. The UPS shall be able to support its' associated rack enclosure in an active state of operation for not less than thirty-minutes.

2.35 IDENTIFICATION PRODUCTS

A. Comply with ANSI/TIA-606-C and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section "Electrical Identification."

PART 3 - EXECUTION

3.01 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.
B. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
C. Install pathways complying with recommendations in ANSI/TIA-569-E, "Entrance Facilities" Article.
    1. Install entrance pathway complying with Division 26 Section "Raceways and Boxes."

3.02 INSTALLATION OF PATHWAYS

A. Comply with ANSI/TIA-569-E for pull-box sizing and length of conduit and number of bends between pull points.
    1. Pull boxes:
        a. Provide pull boxes as required to ensure that no section of conduit exceeds 100’ between accessible pull points.
        b. No section of conduit shall have greater than two 90-degree bends or a cumulative 180 degrees of total bends.
        c. Pull boxes shall be placed in straight sections of conduit and shall not be used in place of a bend.
        d. Pull boxes should be readily accessible and shall be sized per the BICSI TDMM.
    2. Conduit bends:
        a. The inside bend radius for conduit sized 2” or less shall be minimum six times the internal conduit diameter.
        b. The inside bend radius for conduit larger than 2” shall be minimum ten times the internal conduit diameter.
B. Comply with requirements in Division 26 Section "Raceways and Boxes" for installation of conduits and wireways.
C. Install manufactured conduit sweeps and long-radius elbows whenever possible.
D. Pathway Installation in Communications Equipment Rooms:
    1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
    2. Install cable trays to route cables if conduits cannot be located in these positions.
    3. Secure conduits to backboard when entering room from overhead.
    4. Extend conduits 3 inches (76.2 mm) above finished floor.
    5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.03 NON-CONTINUOUS CABLE SUPPORTS

A. Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ /TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer’s installation instructions.
B. Do not exceed load ratings specified by manufacturer.
C. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.
D. Follow manufacturer’s recommendations for allowable fill capacity for each size non-continuous cable support.
E. Bridle rings shall not be used for telecom cable support.

3.04 WIRING METHODS

A. Wiring Method: Install cables in raceways, J hooks, and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables accessible ceilings, walls, and floors except in unfinished spaces.
B. Install plenum cable in environmental air spaces, including plenum ceilings.
C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
D. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
E. Provide equipment frames and ladder racking as outlined in telecommunications series drawings.

3.05 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
   1. Comply with ANSI/TIA-568.2-D and ANSI/TIA-568.3-D.
   2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
   3. Install 110-style IDC termination hardware unless otherwise indicated.
   4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
   5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (762 mm) and not more than 6 inches (152.4 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   6. Cables shall not be painted or exposed to any other building adhesives, paint, coatings, or other foreign agents.
   7. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
   8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
   9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
   11. In the communications equipment room, install a 10-foot long service loop on each end of cable.
   12. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:
   1. Comply with ANSI/TIA-568.2-D.
   2. Do not untwist UTP cables more than 1/4 inch (6.35 mm) from the point of termination to maintain cable geometry.
   3. Terminate patch panels and outlets to a pin/pair assignment as directed by owner.

D. UTP Riser Cable Installation:
   1. Comply with ANSI/TIA-568.2-D.
   2. Do not untwist UTP cables more than 1/2 inch (12.7 mm) from the point of termination to maintain cable geometry.
   3. Terminate patch panels to a pin/pair assignment as directed by owner.

E. UTP Patch Cords
   1. Provide modular cords required to connect LAN switches to modular jacks on cross connect panel shall be furnished as part of this solicitation. Quantities should be equal to the total number of network outlets. At the Patch panel location provide patch cable lengths as needed for a neat installation utilizing vertical wire managers. At the user outlets provide 10 foot (304.8 cm) patch cables for each 8 pin modular connector

F. Open-Cable Installation:
   1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
   2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (203.2 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
   3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. The telecom structured cable shall be supported by its own independent support system.
   4. Plastic “zip-ties” shall not be used. Cables shall be bundled utilizing plenum rated hook and loop type cable ties.

G. Installation of Cable Routed Exposed under Raised Floors:
   1. Install plenum-rated cable only.
   2. Install cabling after the flooring system has been installed in raised floor areas.
   3. Coil cable 10 feet (304.8 cm) long not less than 12 inches (304.8 mm) in diameter below

each feed point.

H. Group connecting hardware for cables into separate logical fields.

I. Optical Fiber Cable Installation:
   1. Comply with ANSI/TIA-568.3-D.
   2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
   3. Fiber shall be installed in innerduct within conduits.
   4. Fiber shall be installed in innerduct within buildings.
   5. Multiple fibers shall be pulled in the same innerduct whenever possible.
   6. Fiber shall be installed in one continuous piece.
   7. Any excess fiber shall be coiled neatly and secured to a wall above the plywood backboard so it is out of the way of normal traffic and is not subject to unusual flexing.

J. Outdoor Coaxial Cable Installation:
   1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
   2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (914.4 mm).

K. Separation from EMI Sources:
   1. Comply with BICSI TDMM and ANSI/TIA-569-E for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
   2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: minimum 5 inches (127 mm)
      b. Electrical Equipment Rating between 2 and 5 kVA: minimum 12 inches (304.8 mm)
      c. Electrical Equipment Rating More Than 5 kVA: minimum 24 inches (609.6 mm)
   3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: minimum 2-1/2 inches (64 mm)
      b. Electrical Equipment Rating between 2 and 5 kVA: minimum 6 inches (152.4 mm)
      c. Electrical Equipment Rating More Than 5 kVA: minimum 12 inches (304.8 mm)
   4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: No requirement
      b. Electrical Equipment Rating between 2 and 5 kVA: minimum 3 inches (76.2 mm)
      c. Electrical Equipment Rating More Than 5 kVA: minimum 6 inches (152.4 mm)
   5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: minimum 48 inches (1219.2 mm)
   6. Separation between Communications Cables and Fluorescent Fixtures: minimum 5 inches (127 mm)

3.06 INSTALLATION OF INNERDUCT

A. Textile innerduct shall be installed as follows:
   1. In a clear 4-inch conduit, two (2) each 3” 3-cell with additional pull tape outside innerducts for future pulls.
   2. Install per manufacturer’s instructions.
   3. Provide suitable slack in maintenance holes, hand holes, pull boxes, and at turns to ensure there is no kinking or binding of the product.
   4. When exposed indoors or in maintenance holes, hold firmly in place using independent supports.

B. Standard Innerduct shall be installed as follows:
   1. In a clear 4-inch conduit, provide three (3) each 1 ¼” innerduct.
   2. In ducts with other cables, as many as possible without damaging the existing cables.

3.07 INSTALLATION TELECOMMUNICATIONS ROOMS

A. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

B. Bond the shield of any shielded cable to the grounding busbar in communications rooms and

spaces.

C. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

D. Free Standing Relay Racks
   1. Assemble relay racks according to manufacturer's instructions. Verify that equipment mounting rails are sized properly for rack-mount equipment before attaching the rack to the floor.
   2. All racks must be attached to the floor in four places using appropriate floor mounting anchors. When placed over a raised floor, threaded rods should pass through the raised floor tile and be secured in the structural floor below. (Use CPI Part Number 40604-003 for concrete slab floors.)
   3. Racks shall be grounded to the TGB using appropriate hardware. The ground will meet local code requirements and will be approved by the Authority Having Jurisdiction (AHJ).
   4. Ladder rack shall be attached to the top of the racks/cabinets to deliver cables to the rack. The rack should not be drilled to attach ladder rack. Use appropriate hardware from the ladder rack manufacturer.
   5. The equipment load should be evenly distributed and uniform on the rack/cabinets. Place large and heavy equipment towards the bottom of the racks/cabinets. Secure all equipment to the racks/cabinets with equipment mounting screws.

E. Ladder Rack
   1. Provide all components of the ladder rack system (ladder rack, turns, splices, supports, and accessories) from a single manufacturer.
   2. Ladder rack shall be installed with side stringers facing down so that the ladder forms an inverted U-shape and so that welds between the stringers (sides) and cross members (middle) face away from cables.
   3. Ladder rack shall be secured to the structural ceiling, building truss system, wall, floor or the tops of equipment racks and/or cabinets using the manufacturer's recommended supports and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ).
   4. Ladder rack splices will be made in mid-span, not over a support, with the manufacturer's recommended splice hardware.
   5. Ladder rack shall be supported every 5' or less in accordance with TIA-569-E. Ladder rack shall be supported within 2' of every splice and within 2' on both/all sides of every intersection. Support ladder rack within 2' on both sides of every change in elevation. Support ladder rack every 2' when attached vertically to a wall.
   6. Heavy-duty splices are recommended for ladder rack in excess of 18" width (18" wide ladder rack). Heavy-duty splices are required for any splice formed in the vertical orientation including changes in elevation formed using vertical-to-horizontal 90° turns or horizontal-to-vertical 90° turns. Use heavy-duty splices to secure all overhead turns to the overhead horizontal pathway(s).
   7. When the pathway is overhead, ladder rack shall be installed with a minimum clearance of 12" above the ladder rack. Leave a minimum of 12" in between ladder rack and ceiling/building truss structure. Leave a minimum of 3" in between ladder rack and the tops of equipment racks and/or cabinets. Multiple tiers of ladder rack shall be installed with a minimum clearance of 12" in between each tier of ladder rack. When located above an acoustical drop ceiling, leave a minimum of 3" clearance between the top of the drop ceiling tiles and the bottom of the ladder rack.
   8. When installed under a raised floor, ladder rack shall be installed with a minimum 3" clearance between the top of the ladder rack and the bottom of the floor tiles or floor system stringers, whichever is lower in elevation. Maintain a 3" clearance between ladder racks wherever ladder racks cross.
   9. Within each telecommunications room, ladder rack should be bonded together, electrically continuous, and bonded to the TGB, unless otherwise noted in the specifications and contract documents. Ladder rack and turns shall be bonded across each splice with a bonding kit. Ladder rack shall be bonded to the Telecommunications Grounding Busbar (TGB) using an approved ground lug on the ladder rack and a minimum #6 grounding wire

or as recommended by the AHJ. Remove paint from the ladder rack where bonding/ground lugs contact the ladder rack so that the lug will contact bare metal. Use antioxidant joint compound in between the bare metal on the ladder rack and ground lug. Use antioxidant joint compound in between the bus bar and the ground lug. Verify continuity through the bonds at splices and intersections between individual ladder rack sections and turns and through the bond to the TGB.

10. The quantity of cables within the ladder rack will not exceed a whole number value equal to 50% of the interior area of the ladder rack divided by the cross-sectional area of the
    a. cable. The interior area of ladder rack will be considered to be the width of the ladder rack multiplied by a height of 2", unless cable retaining posts are added to the ladder rack. The interior area of ladder rack equipped with cable retaining posts will be considered to be the width of the ladder rack multiplied by a height of 6". Actual cable fill for ladder rack that is not equipped with cable retaining posts will not exceed 2" in height. Actual cable fill for ladder rack equipped with cable retaining posts will not exceed 6" in height.
11. The combined weight of cables within the ladder rack will not exceed the stated load capacity of the ladder rack as stated in the manufacturer's product specifications or load/design tables.
12. Cables (cable bundles) will be secured to the cross members of ladder rack with ¾" wide reusable straps. Straps are not required when ladder rack is equipped with cable retaining posts.
13. Add 8" high cable retaining posts to the open sides of ladder rack when cable fill exceeds 2" in height or when cable bundles cannot be secured directly to the ladder rack cross members with a strap. Cable fill within any ladder rack should not exceed 6" in height.
14. When a single ladder rack supports different types of cable media, the cable media will be separated within the pathway by cable spools that attach to the cross members on the ladder rack. Treat each type of cable media and divided area of the ladder rack separately when determining cable fill limits.
15. Use a radius drop to guide cables wherever cable exits overhead ladder rack to access a rack, frame, cabinet or wall-mounted rack, cabinet or termination field. If necessary, provide a moveable cross member also to attach and align the radius drop in between the welded cross members of a ladder rack.
16. Cover the exposed ends of cable runway that do not terminate against a wall, the floor or the ceiling with end caps or an end closing kit.
17. Use auxiliary support brackets that attach to the side stringer of the ladder rack to support interconnect cabling (patch cords, equipment cords, jumper cords) that is routed between racks using the ladder rack. Auxiliary support brackets can be used to support other conductors that should be physically separated from cables within the ladder rack as defined by local code or the authority having jurisdiction (AHJ).
18. Whenever possible, maintain a 2' separation between ladder rack used for communications cables and pathways for other utilities or building services.
19. Provide touch-up paint color-matched to the finish on the ladder rack and correct any minor cosmetic damage (chips, small scratches, etc.) resulting from normal handling during the installation process prior to delivery. If a component is cosmetically damaged to the extent that correction in the field is obvious against the factory finish, the component will be replaced with a new component finished from the factory. If a component is physically damaged due to mishandling or modification during the installation process, it shall not be used as part of the ladder rack system.

F. Vertical Cable Managers
    1. Attach vertical cable managers to the side of the rack/frame using the manufacturer's installation instructions and included hardware.
    2. When a single vertical cable manager is used in between two racks, attach the vertical cable manager to both racks.
    3. When more than one cable manager is used on a rack or group of racks, use the same make, style and size of vertical cable manager on the rack or in between racks.
    4. The color of the racks and cable managers must match.

5. Doors should be attached to the cable manager and in the closed position after cabling is complete.

G. Horizontal Cable Managers
   1. When more than one horizontal cable manager is used on a rack/cabinet or group of racks/cabinets, use the same make, and style of cable manager on the rack/cabinet or racks/cabinets.
   2. The color of the racks and cable managers must match.
   3. Attach horizontal cable managers to the rack/cabinet with four screws according to the manufacturer's installation instructions. Each cable manager should be centered within the allocated rack-mount space (RMU).
   4. Horizontal managers will be located so that the number of ports (cables) they support will not exceed the cable fill capacity of the cable manager.
   5. Covers should be attached to the cable manager and in the closed position after cabling is complete.

3.08 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."
B. General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
C. Install EZ Path floor grid system for all Telecommunications Room floor penetrations with additional quantity as shown on contract drawings.
D. Install EZ Path Series 44 modules for all Telecommunications Room wall penetrations with additional quantity as shown on contract drawings.
E. Install EZ Path or EMT sleeve where horizontal cables penetrate a fire rated wall.
F. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.
G. Comply with ANSI/TIA-569-E, "Firestopping."
H. Comply with BICSI TDMM, "Firestopping Systems" Article.
I. Any penetrations created for the passage of telecommunications which remains vacant at the completion of the installation shall be fire-stopped.

3.09 NON-RATED CABLE PASS-THRU SLEEVES

A. Comply with requirements in Division 07 Section "Penetration Firestopping."
B. General: Install through-penetration systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
C. EZ Path® Series 44 NEZ Smoke and Acoustical Pathway per manufactures instructions
D. EZ Path® Series 33NEZ Smoke and Acoustical Pathway per manufactures instructions
E. Any EMT non-rated wall penetrations created for the passage of telecommunications shall have the annular space filled with mineral wool and Smoke and sound acoustical sealant.
F. Any non-rated EMT wall penetrations created for the passage of telecommunications which remains vacant at the completion of the installation shall be filled with mineral or ceramic fiber stuffing insulation and smoke/sound acoustical sealant.

3.10 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
B. Comply with requirements in *Division 27 05 20* "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
C. Comply with ANSI-J-STD-607-C.
D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.11 VIDEO SYSTEM INSTALLATION - BUILDING INTERIOR

A. Install a completely functional, bi-directional RF Broadband video systems with self-terminating video outlets a built-in 75-Ohm resistor and a connector-actuated switch that automatically terminates the line when a cable connector is removed.
B. Measure, confirm, adjust and test the available signal strength to +20 (in db value) in the main RF distribution amplifier or splitter output port located in the new MC Room.
C. Adjust amplifier gain and make other system adjustments to achieve specified output levels (+3-

6db range) at each outlet. Provide riser drawing with db loss calculations for approval prior to any RF video cable installation.

D. Install Bi-directional Amplifier in the TR/MC and each TR/HC as needed to complete video system adjusting.
E. Install Splitters and taps in each TR as needed to complete fully functional CATV distribution system as specified.
F. The RG-6 station cable shall be supported every sixty (60) inches, and clearly indicate the jack and room number of the station end in indelible ink written on plastic cable tags attached to both ends of the cable.
G. Connectors shall be chosen and installed so they can withstand thirty (30) pounds of pulling force without separating from the cable.
H. Install Multichannel RF Fiber Optic AM Transmitter in the MC of the building location that is to be furnished by owner.
I. Install Multichannel RF Fiber Optic AM Receiver in the MC of the project building.

3.12 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with ANSI/TIA-606-C.
B. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."
C. Comply with requirements in Division 9 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
D. Cable Schedule: Post in prominent location in each equipment room and Telecommunications Room. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an AutoCad or Revit and PDF electronic copy of final comprehensive schedules for Project.
E. Cable Schedule Spreadsheet: Provide sorted by each equipment room and Telecommunications Room. List incoming and outgoing cables and their designations, origins, and destinations. Furnish in Microsoft Excel final comprehensive schedules for Project.
F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for Telecommunications Rooms, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of ANSI/TIA-606-C. Furnish Autodesk Revit and PDF – project version -electronic record of all drawings.
G. Cable and Wire Identification:
    1. Label each cable within 4 inches (101.6 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
    2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
    3. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
        a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
        b. Label each unit and field within distribution racks and frames.
    4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
H. Exposed Riser Cables in j-hooks, Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (457.2 cm).
I. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in ANSI/TIA-606-C.
    1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.13 SOURCE QUALITY CONTROL

A. Factory test UTP and optical fiber cables on reels according to ANSI/TIA-568.2-D and ANSI/TIA-568.3-D.

B. Factory test UTP cables according to ANSI/TIA-568.2-D.
C. Factory test multimode and singlemode optical fiber cables according to ANSI/TIA-526-14-A and ANSI/TIA-568.3-D.
D. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
E. Cable will be considered defective if it does not pass tests and inspections.
F. Prepare test and inspection reports.

3.14 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:
    1. Visually inspect UTP, multi-pair copper and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with ANSI/TIA-568.2-D and ANSI/TIA-568.3-D.
    2. Visually confirm cable category marking of outlets, cover plates, outlet/connectors, and patch panels.
    3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
    4. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
        a. Test instruments shall meet or exceed applicable requirements in ANSI/TIA-568.2D. Perform tests with a tester that complies with performance requirements in "Test
            1) Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    5. Optical Fiber Cable Tests:
        a. Test instruments shall meet or exceed applicable requirements in ANSI/TIA-568.3-D. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
        b. Link End-to-End Attenuation Tests:
            1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to ANSI/TIA-526-14-A, Method B, One Reference Jumper.
            2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in ANSI/TIA-568.3-D.
        c. Optical Time Domain Reflectometer (OTDR) Tests:
            1) Provide OTDR testing for all installed optical fiber links, including all backbone and horizontal links.
            2) Submit OTDR test results to owner upon completion of system installation.
    6. UTP Performance Tests:
        a. Test for each outlet and MUTOA. Perform the following tests according to ANSI/TIA-568.2-D:
            1) Wire map.
            2) Length (physical vs. electrical, and length requirements).
            3) Insertion loss.
            4) Near-end crosstalk (NEXT) loss.
            5) Power sum near-end crosstalk (PSNEXT) loss.
            6) Equal-level far-end crosstalk (ELFEXT).
            7) Power sum equal-level far-end crosstalk (PSELFEXT).
            8) Return loss.
            9) Propagation delay.
            10) Delay skew.

7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to ANSI/TIA-568.3-D.
8. Coaxial Cable and Video Signal Performance Tests: Perform coaxial testing according to ANSI/TIA-568.4-D. Tests shall be performed in the following manner to verify correct installation of coaxial cable and video system electronics:
    a. Output Output @ chi. 7
    b. @450 MHz (175.2 MHz) +6 dBmv (+/- 1 dbmv)
        (a) +40 dBmv after amplifier (+/- 5dbmv)
    c. The output of directional couplers and FFTs shall be at least +9 dBmv.
9. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
    a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
    b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device
        1) at the demarcation point. Log onto the network to ensure proper connection to the network.

C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 inch (256.54 mm) BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

3.15 DEMONSTRATION

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

3.16 REPAIR/RESTORATION

A. Protect adjacent surfaces. Repair damage to any surfaces occurring as a result of the work of this section. Repair of surfaces shall include re-painting in accordance with Division 09 section “Painting.”

3.17 CLEANING

A. At the completion of the system, restore aspects of the project site to its former condition. Remove daily waste and excess materials, rubbish debris, tools and equipment resulting from or used in the services provided under this contract. Remove trash from all work areas. Do not use dumpsters or trash disposal without prior approval.

DIVISION 27 20 00 – AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. *11 52 13* – Projection Screens
C. *27 05 30* – Multimedia Connection Wall Box
D. *27 05 30* – Multimedia Flush Poke-Thru Device
E. *27 30 00* – Multimedia Floorbox
F. *27 05 20* – Grounding and Bonding for Communications Systems
G. Audiovisual (AV) System Drawings
H. Other Drawings
    1. Related Architectural Drawings; for reference only.
    2. Related Electrical Drawings; for reference only.

1.02 REFERENCES

A. Building Industry Consulting Services International (BiCSi),"Telecommunications Distributions

Methods Manual," Fifteenth Edition.

B. American National Standards Institute/Telecommunications Industry Association (ANSI/TIA) - 568.2-D, "Commercial Building Telecommunications Wiring Standard"
C. ANSI/TIA-569-E, "Commercial Building Standard for Telecommunications Pathways and Spaces"
D. EIA/TIA-606D, “Administration Standard for the Telecommunications Infrastructure of Commercial Buildings”
E. EIA/TIA-607-D, “Commercial Building Grounding/Bonding Requirements”
F. National Electrical Code (NEC), 2020 - National Fire Protection Agency (NFPA) 70
G. Institute of Electrical and Electronic Engineers (IEEE) 802.3 Carrier Sense Multiple Access with Collision Detection (Ethernet 10/100/1000/10000 BASE-T)
H. Federal Communications Commission (FCC), Title 47, Code of Federal Regulations, Part 68.
I. National Institution for Certification in Engineering Technologies (NICET)
J. Audiovisual and Integrated Experience Association (AVIXA).

1.03 DEFINITIONS

A. ADA: Americans with Disabilities Act
B. ALS: Assistive Listening System
C. AV: Audiovisual
D. AVIXA: Audiovisual and Integrated Experience Association
E. BICSI: Building Industry Consulting Service International
F. Bid: Herein, used interchangeably with “proposal”
G. CATV: Central or Master Antenna Television (broadband)
H. DSP: Digital Signal Processor
I. IR: Infrared
J. NIC: material and work which is Not In Contract and for which the Installer is not responsible except as otherwise detailed herein.
K. OFE: “Owner Furnished Equipment” which will be provided by The Owner. Be responsible for installing and integrating this equipment as detailed herein.
L. OFCI: “Owner Furnished Contractor Installed” Equipment which will be provided by The Owner. Be responsible for installing and integrating this equipment as detailed herein.
M. RCDD: Registered Communications Distribution Designer
N. RF: Radio Frequency
O. The term “shall” is mandatory.
P. The term “will” is informative.
Q. The term “should” is advisory.
R. Term “provide” means furnish and install.
S. AV Consultant: Convergent Technologies Design Group, Inc.
T. Bidder: Qualified firm intending to tender a bid on the systems described herein.
U. Construction Manager (CM) or General Contractor (GC): The representative responsible for general building construction and onsite coordination between sub-contractors

1.04 BID PROPOSALS

A. Itemized Bid Response
    1. Each piece of equipment shall be individually priced and submitted with Bid Proposals. Provide itemized bid response to include equipment description, manufacturer, model number, unit price, and quantity on a per room basis. All equipment prices shall reflect required modifications and accessories as needed for a complete and functioning system.
    2. Non-equipment charges shall be outlined separately as a single line item on a per room basis. A sum of the audiovisual system total cost shall be provided with the bid proposal.
    3. Be responsible for all equipment and installation as indicated in the construction documents. Any equipment omissions or modifications in the itemized bid response shall not serve as direction to omit or modify project scope without explicit written agreement from the owner, architect, and AV consultant.
B. Contractor Qualification
    1. Demonstrate at least three (3) years’ experience in fabrication, programming, assembly, and installation of audiovisual presentation and remote-control systems of similar magnitude and quality as specified for the subject job. Submit documentation to this effect with the bid response. Be an authorized sales and service center for all listed components

and offerings in this specification.
    a. The AV contractors own forces, at a minimum, are to perform the AV system Programming.
2. References: Furnish no less than three (3) references for installations of similar size (dollar amount & quantity of spaces receiving integrated technology) and scope, performed within the past three (3) years. At a minimum, reference information will include the reference company or institute name, contact person's name and title, telephone number, address, and detailed project description, project manager's name, and contact information of the organization that is responsible for day-to-day operation of the audiovisual installation.
3. Programming shall be completed by contractors' own staff.

C. Alternate Proposals
1. Any proposed alternate equipment choices should be requested in writing prior to the proposal submission for approval. Each item on the alternate equipment list must be accompanied by catalog cut sheets and technical specifications.

D. Non-Equipment Charges, including but not limited to:
1. Engineering: Including all required design drawings, run sheets, instruction manuals, console layout, step-by-step user guide, etc.
2. Pre-Installation: Work performed on the Installer's premises including all fabrication, modification, assembly, rack wiring, etc.
3. Installation: Including all on-site installation and wiring, shop drawing, coordination and supervision, testing, checkout, Owner training, etc., performed on the Owner's premises.
4. General and Administrative: Including all shipping, insurance, and guarantees.

E. Owner Furnished Equipment (OFE, OFCI)
1. Identify any Owner Furnished Equipment assumed in the Bid Proposal to be installed and integrated under this contract. Identify all assumed Owner Furnished equipment within each room/space type that will be required to complete the AV systems installation.

F. State of the Art Development
1. Supply only the manufacturer's latest developed product. In cases where product development surpasses the criteria of the specification, inform the Architect and make the newer product available to the project at no additional cost. In no case shall discontinued or obsolete equipment be acceptable. The same requirement applies to software programs developed/updated during the warranty period.
2. Should a manufacturer discontinue a specified product, provide the manufacturer's recommended replacement at no additional cost to the owner. Should the manufacturer have no direct replacement product, Propose a product of equal or greater specification from an alternate manufacturer at no additional cost to the owner.
3. Should a product recall by a specified manufacturer require temporary or permanent replacement of a product specified under this section, notify the Architect at the earliest possible time and arrange to replace the product in question as quickly as possible.
    a. Equipment found defective or subject to recall prior to scheduled installation shall not be delivered to the jobsite.
    b. Equipment defect or intended recall shall not relieve the AV Contractor from any contractual obligations with regard to delivery schedule of product.
    c. Under no circumstances shall arrangement for alternate product require the Owner to accept superseded equipment except on a temporary basis.

G. Service Contract
1. Submit the costs for a one-year service contract, renewable for up to three years, which shall commence with the completion of the two-year warranty period. These contracts shall be fixed-cost and can be accepted at the option of the Owner.
2. The service contract shall include all services provided during the warranty period, including complete replacement or repair of defective equipment.

1.05 QUALITY ASSURANCE

A. Coordination
1. Coordinate this Section with work of other Project Manual sections and associated trades.
2. Specific references, herein, requiring coordination of certain work shall not obviate responsibility for other required coordination.

B. Standards and Codes
    1. Comply with
        a. Local, state and federal codes
        b. Applicable National Electrical Code
        c. American National Standards Institute
        d. Underwriters' Laboratories, Inc. standards.
    2. All equipment, material, accessories, and loose items provided shall be new and shall conform to applicable requirements of the above-mentioned agencies.
    3. If required by local authorities, provide certificates and labels indicating compliance with above-mentioned codes and standards where applicable.
C. Point of Contact
    1. Designate to the Owner in writing, the responsible person who shall ensure timely and consistent communication with the Owner on progress of the contract. The designated representative shall have full knowledge of all engineering and production procedures and shall report status of the installation and upcoming work plans to the Owner's Project Manager and Consultant on a weekly basis.
    2. Project manager shall have successfully managed not less than two (2) projects of similar size and scope (as defined in previous sections). Bid submission shall detail the percentage of time that the project manager and other key personnel will be involved with the project.

1.06 SCOPE OF WORK

A. Provide the following in accordance with Specifications and Drawings:
    1. Submittals delivered in a timely manner as described hereinafter.
    2. Verification of dimensions and other conditions at project site. Review Conduit System as shown in building Construction Documents and, where applicable, as-built conditions. Notify Consultant, Architect, GC, and EC within four weeks after award of contract of any deficiencies or inadequacies in conduit/infrastructure system design. Review Telecommunications Structured Cabling System to ensure sufficient network connections are provided to support the Audiovisual Systems.
    3. Review all AV equipment mounting and rack enclosures to verify dimensions, power provisions, and ventilation. Notify Consultant, Architect, GC, and EC within four weeks after award of contract of any deficiencies or inadequacies in equipment rack enclosures and mounting locations.
    4. Detailed design of Digital Signal Processor system "maps," including remote-control accommodations.
    5. Complete programming of audiovisual remote-control system inclusive of graphical layout and source code programming
        a. Programming shall be completed by contractors' own staff.
    6. Power distribution within equipment racks including power connection to electrical outlets as described in the electrical sections of the building construction documents.
    7. Incidentals necessary for a complete working system.
    8. Initial testing and adjustments, demonstration of system for approval, participation in acceptance tests, final adjustments as required.
    9. Record Documents, "As-Built" drawings and Owner's Manual.
    10. Training of operating personnel.
    11. Notify appropriate parties of conflicts in a timely manner.
    12. Work cooperatively with other trades to resolve conflicts.
B. Special Insurance
    1. Provide insurance fully covering all equipment against loss and damage during shipment, storage, installation, testing, adjustment and demonstration.

1.07 SYSTEM DESCRIPTION

A. Design Intent
    1. Provide a complete and functioning audiovisual (AV) system inclusive of all hardware, software and training to meet or exceed the performance features outlined in this document.

B. Design Standards
   1. The Owner's goal is to have available a cohesive and fully functional system. Therefore, part of the development efforts for successfully implementing the AV systems should include:
      a. Install the system in a manner that complies with BiCSi and AVIXA cable routing standards. Route all audio, video, and control cabling elements in a subtle, unobtrusive manner to maintain the architectural and visual integrity of the building.
      b. Except where plenum cable is used above finished ceilings, it is required that all cabling be routed inside the comprehensive system of conduit. Floor and wall boxes shall serve as the primary interface points to the AV system.
      c. Provide and install cover plates, connectors, and associated cabling to link all floor and wall boxes to all affiliated local and remote AV components. No wiremold or surface- mounted raceway will be permitted unless explicitly specified. Coordinate faceplate materials, colors, and finishes with the faceplates used by other trades on the project and the architect to match aesthetics.
      d. Provide and install security covers on any electronics with front panel controls that should not need to be adjusted after initial set-up. All components permanently mounted to rack rail systems shall be installed with industry accepted security screws.
      e. All ceiling mounted AV equipment shall be secured to building structure.
      f. No more than thirty lamp hours shall be expired for projection system set-up at the time of final systems acceptance. Should more hours than this be expired, replace the lamp at no cost to the Owner.
      g. Steel cable security systems and padlocks to secure structure shall be provided for all surface-mounted loudspeakers, document cameras, video cameras, flat panel displays, and projectors. All padlocks provided for security shall be keyed to a single master key.
      h. Provide an intellectual property release and install an editable version of all master source code for all digital signal processing, remote control or microprocessor-based systems included on this project to an owner furnished personal computer. Also provide a hardcopy on portable media.
      i. Provide necessary audio, video, RGBHV, HDMI, DVI, USB, and control signal repeaters, extenders, and amplifiers for any run greater than 30 feet (914.4 cm) and as needed to maintain required signal levels for receipt at destination device. All audio lines shall be balanced at the source, prior to any cable pull longer than 20 feet (609.6 cm). There are no exceptions.
      j. Video camera locations shall receive AC power from associated equipment rack low voltage transformers within 60 feet (1828.8 cm).
      k. For each input/output point of interface to the system, provide a suitable length patch cord for owner use for every signal type present. Provide umbilical style cable management for any mobile solutions.
   2. Performance Standards: Unless restricted by the published specifications of a particular piece of equipment, or unless otherwise required, the following minimum performance standards shall be met by each system:
      a. Analog Audio:
         1) 75 dB minimum
         2) 0.5% maximum from 30 Hz to 15,00Hz.
         3) Flat within +1.0 dB, 30 Hz to 15,000Hz.
      b. Analog Video:
         1) S/N (peak to RMS) unweighted DC to 4.2 MHz: 45-dB minimum
         2) 45 dB minimum
         3) Within +0.5 dB to 10 MHz
         4) Within +0.5 dB to 100 MHz
         5) 2% maximum
         6) 3% maximum
         7) 2 degrees maximum
      c. Digital Visual Interface (DVI):

1) Support up to 165 MHz
2) Support DDC

d. High-Definition Multimedia Interface (HDMI):
1) Support up to 340 MHz
2) Support Deep Color and 3D
3) Support HDR, 60fps, 4:4:4
4) Supported

e. AV Over IP
1) Support up to 1080p/60
2) Support up to 4K/60, 4:2:2
3) Support up to 4K/60, 4:4:4
4) Support minimum 1080p/60
5) The latency for all in-room sources visible within a given space shall not exceed 30ms.

f. Network Audio:
1) minimum 48kHz, 24-bit, 64i/64o
2) minimum 48kHz, 24-bit, 64i/64o

g. Performance Test Signal Paths: The signal paths for the above Performance Standards shall be as follows:
1) Audio: From any and all source inputs (for microphones, computers, wireless presentation gateways, etc.) through all audio processing, preamplifiers, audio distribution amplifiers (ADA), mixers, switchers, codecs, encoders, decoders, etc., to all electrical signal destinations.
2) Video: From all source inputs (for cameras, computers, wireless presentation gateways, etc.) through all distribution amplifiers (VDA), processors, switchers, matrices, encoders, decoders, transmitters, scalers, etc., to all signal destinations.

h. Remote-Control Standards: As a minimum, the remote-control system for each space shall be programmed to include the following:
1) Owner Logo on first page.
2) Automatic System Shutdown.
3) AM/PM Clock Settings.
4) 50% or other reasonable audio level default.
5) Separate Program and Microphone Audio Level Control with mute function.
6) Volume/Mute controls for program and speech audio reinforcement on every screen.
7) Panel layout to include user screens with separate, password protected technician pages.
8) Raise and lower the projection screen when projection is powered off/on, respectively.
9) Assign the room computer as default system source upon power up.
10) Activate a minimum of three (3) presets for each installed remote-controllable video camera.
11) Provide remote-control room management software and full licensing for each system on the project.
12) Full function control of all source components, display units, processing devices and switching electronics.
13) In sub-dividable spaces, provide both IR and closed contact partition sensor control, and automation of control system scenarios. Provide an additional option for manual override within a password-protected technician page.
14) Touch panel page layouts shall be submitted for approval. Prior to designing touch panel layouts, meet with the Owner to review existing control system standards on campus and determine a basis of design.
15) Follow-up programming and modifications as requested by the Owner shall be provided 6 months after system acceptance. Provide and install updated editable

source code to the Owner following these updates.

16) In the event the remote-control system programming becomes compromised during the warranty period, provide the necessary effort to make the system fully functional once again.

C. Category Rated Cabling

1. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
2. The maximum allowable horizontal cable length is 295 feet (8991.6 cm). This maximum allowable length does not include an allowance for the length of 16 feet (487.68 cm) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

1.08 SUBMITTALS

A. Related Sections

1. Comply with requirements of *Division 01 30 00*, “Submittal Procedures.”

B. Submittal Data

1. Submittal data is to be submitted as a complete, single digital file. All documents shall be clearly legible. Each submittal shall contain the below in the following order:
   a. Cover Sheet
      1) Include name of supplying contractor and project name.
      2) Include submittal and revision number.
   b. Detailed Bill of Materials
      1) Include a listing of: component quantities, equipment manufacturers, model numbers, descriptions of each component being supplied, and the specification paragraphs or drawing sheets that correspond to each product.
      2) The bill of materials shall be index referenced within the PDF file so that each product name is clickable, linked to the first page of the corresponding product data.
      3) Failure to provide this information will result in the rejection of submittals.
   c. Product Data
      1) Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product.
      2) Photocopy duplications of the manufacturer’s original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures.
      3) If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight. All optional components and selections shall be clearly indicated.
   d. Authorized Distributor Certificate
      1) Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is an Authorized Distributor of the product being supplied.
   e. Prequalification Warrantee - Category Rated Cabling
      1) Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is Authorized to obtain for the owner the Special Warranty for Cabling System and the Special Warranty for System Assurance.
   f. Submittal shall be a single PDF file.
      1) Partial submittals, or submittals comprised of multiple PDF files, will be rejected.

C. Shop Drawings

1. Prior to fabrication submit contractor-generated drawings for approval for all supplied systems. These drawings shall include, but are not limited to, the following:
   a. Title Sheet with sheet index and symbols legend

1) Include a list of all drawings in the set and a symbols legend defining each symbol used in the package.
b. All panels, plates, and designation strips, including connectivity, layout, labeling, and details relating to terminology, engraving, finish and color
c. All equipment racks, cabinets, consoles, tables, carts, support bases, and shelves
d. Schematic drawings (AV & Control Signal Flows), system functional block drawings, including those for audio and video subsystems
e. All unusual equipment modifications
f. Equipment rack elevations
g. Equipment location drawings
h. Dimensions for all AV equipment racks and enclosures, verifying adequate space, power, and ventilation are provided
i. Cable labeling plan
j. Floor Plans, RCPs and Elevations:
1) Show planned location for all elements and cable routing.
2) Indicate projector distance, throw ratio, and lens.
3) For any inductive loop assisted listening systems, indicate the inductive loop pathway.
2. Drawings should be at project standard scale and clearly legible.
3. Resubmission of contract drawings does not constitute a complete shop drawings submittal and is unacceptable. Such submittals will be rejected.

D. Form
1. Submit all materials for review as described above, specifically referenced to the specification paragraph number (where applicable).
a. Submit all drawings on sheets of one size, preferably the project standard size.
b. On submittal drawings, maintain 3/32” minimum lettering height. Submittals with text less than 1/16” in height may be rejected.
2. Partial Submittals may be rejected. If submitted individually and each in its entirety, the following submittals shall not be considered partial:
a. Personnel
b. Milestones
c. Conduit Verification Statement and Notifications
d. Rigging and Mounting Drawings
e. As-Built Documentation
3. Product Data and shop drawings must be submitted together in order to be reviewed.

E. User Interface
1. In order to develop a user interface which is both functional and useable, provide working “Beta” copies of system software for review and comment by the owner, architect and the AV consultant as per the below listed schedule:
a. This is anticipated to be an interactive process, requiring at least three submittals prior to first beneficial use. At a minimum, the software development process will have the following milestones:
1) Initial concept submittal for review
2) First Beta Review
3) Second Beta Review
4) Final implementation and onsite training: Prior to final acceptance
5) Follow-up programming review and updates: within sixty-days from final acceptance

F. Weekly Reporting
1. Commencing with project award, provide weekly status reporting of milestone task status, anticipated completion date, and related memo notes for the following tasks:
a. Submittals
b. Infrastructure verification
c. Pre-wire status
d. Equipment Procurement

e. Shop fabrication
f. Remote control system design
g. Installation and Terminations
h. Field testing and pre-acceptance testing
i. Final acceptance demonstrations
j. Owner training
k. First owner use
l. Open Coordination Items and Questions

G. Personnel
1. Provide, in writing, within two weeks after award of Contract, the names, mailing address, phone numbers with extensions, email addresses and paging service numbers (if available) of the following project personnel:
a. Project Manager
b. Lead Systems Engineer
c. Field Foreman
d. Remote Control System Programmer

H. Conduit Verification
1. Within four weeks after award of Contract, submit statement confirming that the conduit system as designed in building construction documents has reviewed and, where applicable, as built.
2. Notify Consultant, General Contractor, Architect or Electrical Contractor of deficiencies or inadequacies, if any, in conduit system design or installation. If none, so indicate.
3. Absent conduit verification and after installation of conduit as designed, assume costs of equipment, materials, labor and engineering, including services of owner's
a. representative(s) in designing and/or verifying revised wiring approach(es) as relate to providing a fully functional system using conduit as designed or as revised at the discretion of the owner.

I. Rigging and Mounting Drawings
1. Submit full size drawings outlining mounting and installation details of all AV equipment requiring integration with cabinetry or architectural elements. Verify adequate space, power, and ventilation are provided.
2. Details, stamped and signed by an appropriately licensed engineer, of all equipment mounting methods and materials provided by the Scope of Work, wherein failure of method or materials used for mounting or hanging permanently installed equipment could result in serious personal injury.
a. Details provided by or requiring approval by licensed engineer may include: method of attachment to building structure or attachment and/or suspension points; method of attachment to supported equipment; all suspension materials; a materials list including specifications of all suspension materials; calculations used to determine loads and strengths of suspension materials, other as deemed necessary by the engineer.
3. In the absence of submitted approved, stamped and signed mounting and hanging details, the Owner reserves the right to acquire such engineering approval at the expense of the Contractor. Owner will notify Contractor of such intent. Remedy within two weeks or Owner may proceed without Contractor approval and without relieving Contractor from any other obligations set forth by Contract.

J. Color Selection
1. Indicate color options for all items as applicable.
2. Coordinate wallplate finishes with the Architect.

K. Samples
1. Provide color and finish samples of any furniture or lecterns.

1.09 CLOSEOUT SUBMITTALS

A. At the completion of the installation, but before Final Acceptance, provide for review and approval the following, in compliance with Division 1 Section Closeout Procedures.
1. Operation and Maintenance Manuals:
a. Equipment manufacturer's operation and service manuals for each make and model of equipment.

b. System Operation Manual. Produce a manual specifically for the subsystems detailed herein. The manual shall describe all procedures necessary to activate each system and provide the functional requirements, except as specifically excluded by the Owner. This section shall provide a simple “How-to” user’s guide for the procedures needed to operate the system. This document shall contain a section on operating the systems equipment in the event of control system failure. Control system touch panel layouts shall be accompanied by narrative text describing “step-by-step” function engagement.

2. Warranty
   a. Provide list and dates of activation of equipment warranties.
   b. Provide original manufacturers’ certificates.
3. As-built Drawings
   a. Include contractor-generated digital record diagrams for all systems including, but not limited to:
      1) Schematic wiring diagrams with cable markings
      2) Internal wiring diagrams of the equipment rack cabinets
      3) Custom equipment modifications
      4) Final test results and nominal settings for all adjustable controls
   b. Resubmittal or markup of contract documents will not be accepted.
4. AV Passwords and Security
   a. Software Passwords Schedule (i.e., a spreadsheet listing the manufacturer, model number and location in the Facility, of each piece of audio/video equipment, the software for which is password-protected)
   b. Provide to Owner’s Representative as a secure document, separate from Operations and Maintenance Manuals and As-Built Drawings.
   c. IP address schedule for all network-addressable AV devices
5. Editable Control System Code
   a. Provide the final control system code in an editable format.
6. Laminated Instruction Cards
   a. Provide 8 ½ x 11 Instruction cards, approved by the Owner. Laminate step-by-step instructions outlining system operations for each room that has an AV system. Provide editable file of card to Owner.

1.10 IDENTIFICATION CATEGORY RATED CABLING

A. Identify system components, wiring, and cabling complying with ANSI/TIA-606-C. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."

B. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of ANSI/TIA-606-C. Furnish AutoCad - latest version - electronic record of all drawings.

1.11 DELIVERY, STORAGE, HANDLING, AND STAGING

A. Supply, transport, deliver, unload, move to the installation location, unpack, place, assemble, secure, connect, and install all equipment needed to complete the installation. Be responsible for transportation, parking, delivery, and on-site storage of the system’s equipment. Be responsible for all transportation of personnel to and from the site.

B. Reconfirm before delivery that hallways, stairways, passages, doorways, rooms, entries, elevators and foyers are of sufficient size to accommodate the passage and installation of the equipment and systems. Offsite pre-staging of goods is encouraged.

C. The Owner’s acknowledgment of delivery of goods and any payment made on account of such delivery shall not constitute acceptance (partial or otherwise) and shall not diminish obligations as specified.

D. The actual dates of delivery shall be under the absolute control of the Owner. The dates and times for delivery/installation are critical to the successful completion of the project. Deliveries shall normally be accepted only Monday through Friday 8:00 a.m. to 4:00 p.m. In the event it becomes necessary for goods to be installed outside these hours comply with the instructions of

the Owner. Deliveries attempted outside these hours without prior consent of the Owner may be turned away. Comply with all instructions of the Owner and the Contractor concerning time of arrival at the site; which entrance shall be utilized for delivery; routes to be taken to reach the installation location; and other matters relating to the orderly and timely installation of the system.

E. Installation shall commence immediately upon delivery of materials to the jobsite, except as directed by Construction Manager. Time required from delivery date to completion of project shall be in accordance with the approved schedules.

1.12 SYSTEM TRAINING

A. Training: Provide training in the operation and maintenance of the system for personnel designated by the Owner. Record owner training sessions on DVD or other agreed upon media, and make training videos available to the owner at no charge. The training shall be organized as follows:
   1. Two (2) two-hour training classes for system technical operation and maintenance. This class shall cover the following topics:
      a. Review of signal flow diagrams
      b. Review of all equipment functions, relevant to the function in this system
      c. Review of initial equipment settings
      d. Demonstration of all functional connections from a user perspective
      e. Review & demonstration of replacement procedures for consumables (e.g., lamps)
      f. Review of manufacturers' recommended routine maintenance procedures
   2. Two (2) two-hour training classes for system engineering concerns. This class shall cover the following topics:
      a. Review of signal flow diagrams
      b. Review of all equipment functions, relevant to the installation
      c. Review of initial equipment settings
      d. Review of manufacturer's recommended routine maintenance procedures
      e. Review & demonstration of replacement procedures for consumables (e.g., lamps)
      f. Review & demonstration of control system software replacement/upgrade procedures
   3. Two (2) four-hour training classes addressing AV system operations. The classes will demonstrate and describe the following:
      a. System set-up and operations
      b. Control system operation
      c. How to attach microphones, record AV signals, and control the sound system
      d. Videoconferencing operation & capabilities (if applicable)
      e. Audio monitoring and ADA system operations
      f. Cable antenna television system (CATV)
   4. Training may take place at any time (chosen by the Owner) after the systems are operational, up to a year following system acceptance.
   5. Closeout submittals shall be provided prior to any training classes.
   6. Coordinate detailed specifics of the training session(s) time, date, and location with the Owner.

1.13 WARRANTY

A. The system warranty shall be for twenty-four (24) months from the date of final acceptance. Provide all equipment, material, and labor required to uphold a full system warranty at no charge to the Owner. All manufacturers' equipment warranties shall be activated in the Owner's name and shall commence on the date of final acceptance. In the case of modified equipment, the manufacturer's warranty is normally voided. In such cases, provide the Owner with a warranty equivalent to that of the original manufacturer.

B. There shall be no cost to the Owner for maintenance performed during the warranty period beyond the fixed cost of the contract.

C. Coordinate and provide updates to the control system code & touch panel layouts based on owner feedback of desired functionality during warranty period.

D. Provide a total of eight (8) one-day visits per year, or a total of sixty-four (64) engineering/ service labor hours to conduct preventive maintenance and the Owner directed system adjustments.

E. Each visit will include:

1. Cleaning optical lenses
2. Checking and replacing projection lamps filters and indicators
3. Checking and repairing microphones and microphone cables
4. Conducting subjective and objective tests of the audio, video, and control systems of the installed audiovisual systems

F. Repair and adjust any malfunctioning components located by the technician during this testing. Include control system programming updates and modifications as part of this service contract, providing an updated editable copy of the source code to the Owner.
G. Provide a service telephone number, staffed by a qualified technician familiar with the equipment installed. Staff this number during normal business hours.
H. Respond with an on-site technician within 24-hours of a service call (including Saturdays and Sundays) for all equipment and system failures.
I. Replace or repair, at no cost to the owner, any failed equipment hardware or software installations required to provide full system operations.
J. During the warranty period, advise the Owner in writing each time any routine software and firmware updates become available, giving the Owner the opportunity to upgrade the
    1. software/hardware should they so desire at no additional cost. Provide any necessary system modifications after installation of these updates to maintain a fully functioning system.
K. Provide updates to firmware during service period. Provide any necessary system modifications after installation of these updates to maintain a fully functioning system.

1.14 WARRANTY CATEGORY RATED CABLING

A. Special Warranty for Cabling System: Manufactures warranty shall ensure against product defects; that approved cabling components exceed the specifications of ANSI/TIA-568.2-D, ANSI/TIA-568.3-D, and ISO/IEC IS 11801; exceed the attenuation and NEXT requirements of ANSI/TIA-TSB-67 and ISO/IEC IS 11801 for cabling links/channels; and that the installation will exceed the loss and bandwidth requirements of ANSI/TIA-TSB-67 and ISO/IEC IS 11801 for fiber links/channels. The warranty shall apply to passive SCS components.
    1. Warranty Period: Substantial Completion
    2. Cabling System from date of
B. Special Warranty for System Assurance: Manufactures warranty shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional application(s) introduced in the future by recognized standards or user forums that recognize ANSI/TIA-568.2-D, ANSI/TIA-568.3-D, or ISO/IEC IS 11801 component and link/channel specifications for cabling.
    1. Warranty Period:
        a. date of Substantial Completion PART 2 - PRODUCTS

PART 3 - EXECUTION

2.01 INSTALLATION

A. General:

APPLICATIONS ASSURANCE FROM

1. All installation work shall be in accordance with, but not limited to, this specification and drawings. Work practices shall be performed in accordance with applicable standards, requirements, and recommendations of Federal and Local authorities having jurisdiction.
2. All discrepancies discovered and any discrepancies which are apparent at the date of submission of bids, shall be immediately corrected without additional charge to the Owner.
3. Clearly label all user controls for intended use and nominal setting. These labels shall be engraved and filled, or equal. “Dymo” labels are not acceptable.
4. All equipment shall be rack mounted supplied with the appropriate rack mount kits.
5. Install in each rack enclosure a power distribution panel. Locate power distribution panel in the first available rack unit.
6. All equipment racks to include removable, locking front doors and a 4” diameter, low-noise fan.
7. All rack and instructor stations shall include “security type” screws to secure rack-mounted components.
8. In rooms containing wireless microphones or an assisted listening system, provide an

antenna distribution system inclusive of remote antennas as needed to support complete and consistent coverage throughout the space(s).

9. In rooms containing auto-tracking camera systems, provide one (1) day of manufacturer setup and programming.
10. In rooms containing steerable microphones or loudspeakers, provide one (1) day of manufacturer setup and programming.
11. Provide one (1) spare replacement lamp for each projector specified.

B. Physical Installation:
1. Provide system identification plate as shown below. Plate shall occupy the first available rack unit in all AV equipment racks. If more than two (2) racks are positioned together, one (1) plate for every two racks is acceptable. Product: Custom Covid plate # 1LR-CTD- 001.
2. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Unless granted specific permission by the Owner, install and secure all boxes, equipment, etc., plumb and square.
3. Fastenings, mounting brackets and supports shall be adequate to support their loads with a safety factor of at least five (5). A safety chain or cable will be tied to all equipment suspended from above.
4. All motorized projector lifts shall support their loads with a safety factor of at least five (5) and shall be capable of lowering the equipment to a serviceable height (to at least 48" AFF). When retractable to a position flush with the ceiling surface, provide a matching cover in coordination with the architect and ceiling installer. Center lift covers within ceiling elements and minimize impact to room aesthetics.
5. In the installation of equipment, cable, and other elements, consideration shall be given not only to operational efficiency, but also to overall aesthetic factors.

3.02 AUDIOVISUAL CABLE INSTALLATION

A. All cables, regardless of length, shall be marked with wraparound cable markers at both ends. There shall be no unmarked cables at any place in the system. Marking codes used on cables shall correspond to codes shown on "as-built" drawings and/or run sheets. The labeling and numbering system shall be coordinated with the Owner.
1. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in ANSI/TIA-606-C.
a. Cables use flexible vinyl or polyester that flex as cables are bent.

B. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

C. All wired microphones shall include a 30ft. patch cable with heavy-duty jacket and XLR connectors. Provide local microphone preamp for all wired microphone runs longer than 30ft.

D. Loudspeakers operating at 4/8/16 ohms shall be installed with 12AWG cable as a minimum size/ diameter.

E. Wall plate and floor box input/output panels shall be installed with audio/video line drivers for runs exceeding 35ft.

F. All cabling shall be neatly strapped, dressed, and adequately supported. Any exposed cabling shall be neatly enclosed in a protective covering.

G. Plastic "zip-ties" shall not be used. Cables shall be bundled utilizing plenum rated hook and loop type cable ties.

H. Terminal blocks, boards, strips, or connectors shall be furnished for all cables, which interface, with racks, cabinets, consoles, or equipment modules.

I. AV cabling shall terminate at all floor boxes, wall plates, back boxes, and other infrastructure connection points with patch cables from terminations to source/sink devices (i.e. permanent system cabling may not pass directly through the infrastructure to connect directly to room devices).

J. All audio signal lines shall be balanced at AV I/O plates. Provide ninety (90) degree connector adapters for all AV cabling at custom AV I/O plates.

K. All cables shall be grouped according to the signals being carried. In order to reduce signal contamination, separate groups shall be formed for the following cables:
1. Power cables
2. RGBHV, Video cables and control cables

3. Data cables
4. Audio cables carrying microphone level signals
5. Audio cables carrying line signals
6. Audio cables carrying amplified loudspeaker level signals

L. Install plenum cable in environmental air spaces, including plenum ceiling.

M. All cables shall be cut to the length dictated by the run plus the required service loop to permit future equipment movement and relocation. For equipment mounted in drawers or on slides, the interconnecting cables shall be provided with a service loop of appropriate length.

N. No cable shall be installed with a bend radius less than that recommended by the cable manufacturer. Notify the construction manager if field conditions will interfere with the proper installation of any cables or equipment.

O. Grounding Procedures: In order to minimize problems from improper grounding and to maximize signal-to-noise ratios, adhere to the following grounding procedures:
1. General: Deviate from these practices only when necessary to minimize crosstalk and to maximize signal-to-noise ratios in the audio, video, and control systems. Inform the Consultant in the event that there is a deviation from the standard grounding practices prior to performing the work.
2. Bond the shield of any shielded cable to the grounding busbar in AV rooms and spaces.
3. System Ground: A single “system ground” shall be established for the system. All grounding conductors shall connect to this system ground. The system ground shall be provided in the equipment rack and shall consist of a copper bar of sufficient size to accommodate all secondary ground conductors.
4. A copper conductor, having a maximum of 0.1 Ohms total resistance, shall connect the system ground bar to the nearest grounded, metallic electrical conduit of at least 2 inches (50.8 mm) in diameter. Be responsible for determining if the metallic conduit is properly electrically bonded to the building ground system and provide a drawing as part of the grounding system documentation indicating the grounding pathway.
5. Secondary system grounding conductors shall be provided from all ungrounded equipment in each area, to the primary system grounding point for the area. Each of these grounding conductors shall have a maximum of 0.1 Ohms total resistance.
6. Under no conditions shall the AC neutral conductor, either in the power panel or in a receptacle outlet, be used for a system ground.

P. Audio Cable Shields: All balanced audio cable shields shall be grounded at one point only. For ungrounded portable equipment, such as microphones, the shield shall be connected at both ends but grounded at only one end.

Q. Video Receptacles: All video receptacles shall be insulated from the mounting panel, outlet box, or wireway.

R. Non-continuous cable supports
1. The AV structured cable shall be supported by its own independent support system.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
3. Suspend cable a minimum of 8 inches (203.2 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
4. Audiovisual cables shall be supported AFC with adjustable non-continuous cable supports.
5. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of audiovisual cables.
6. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
7. Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and the manufacturer’s installation instructions.
8. Do not exceed load ratings specified by manufacturer.
9. Follow manufacturer’s recommendations for allowable fill capacity for each size non-continuous cable support.

S. Separation from EMI Sources:
1. Comply with BICSI TDMM and ANSI/TIA-569-E for separating AV cabling from potential

EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: minimum 5 inches (127 mm)
   b. Electrical Equipment Rating between 2 and 5 kVA: minimum 12 inches (304.8 mm)
   c. Electrical Equipment Rating More Than 5 kVA: minimum 24 inches (609.6 mm)
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: minimum 2-1/2 inches (64 mm)
   b. Electrical Equipment Rating between 2 and 5 kVA: minimum 6 inches (152.4 mm)
   c. Electrical Equipment Rating More Than 5 kVA: minimum 12 inches (304.8 mm)
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement
   b. Electrical Equipment Rating between 2 and 5 kVA: minimum 3 inches (76.2 mm)
   c. Electrical Equipment Rating More Than 5 kVA: minimum 6 inches (152.4 mm)
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: minimum 48 inches (1219.2 mm)
6. Separation between Communications Cables and Fluorescent Fixtures: minimum 5 inches (127 mm)

3.03 REPAIR/RESTORATION

A. Any damage to any installed work or product caused by the unpacking, transporting, assembly, connecting, or configuring of the product shall be repaired at no charge to the Owner.

3.04 FIELD QUALITY CONTROL

A. Once installed and the System Checkout is complete, the system shall be demonstrated as operational to the Owner.
   1. If the AV system fails to meet the requirements of this document or those stated by the technical documentation, then the Owner shall reject the installed system and the contractor shall be given notice (either oral or in writing) to correct the failure.
   2. If unable to overcome repeated performance deficiencies within thirty (30) days, and if requested to do so by the Owner, remove the equipment and replace at no expense to the Owner.
   3. No warranties shall begin until the Owner has authorized final acceptance in writing.
   4. Right to Revoke Acceptance: If any equipment and/or goods which have been previously accepted, specifically or by the making of payment, are found to have defects, damage, or deficiencies, or fail to conform to the specification, for any cause not attributable to the Owner, the Owner may revoke acceptance.

B. Conduct pre-acceptance tests
   1. Perform all system performance checks on the installed systems prior to final acceptance testing. The Owner / AV Consultant may witness the pre-acceptance tests. The Owner / Architect may inspect and operate system components in order to evaluate installation progress and technical compliance prior to acceptance testing.

C. Contractor System Checkout
   1. Perform system checkout before acceptance tests are scheduled. Furnish all required test equipment. Perform all work necessary to determine and/or modify performance of the system to meet the requirements of this specification.
   2. During performance testing, all equipment shall be operated under standard conditions as recommended by the manufacturer.
   3. Test all audio and video systems for compliance with the Performance Standards using test procedures that follow later in this specification.
   4. Maintain documentation of all performance tests for reference by Consultant during System Acceptance.
   5. At the conclusion of the tests, return all equipment settings to previously calibrated positions.
   6. Provide written records of all test results in spreadsheet form.

7. Check all control functions, from all controlling devices to all controlled devices, for proper operation.
8. Adjust, balance, and align all equipment to optimize quality and meet the manufacturers' published specifications. Establish and mark normal settings for all level controls and record these settings in the "System Operation and Maintenance Manual."
9. Provide testing results and settings for all equipment and systems to the AV Consultant at least three (3) business days prior to System Acceptance Testing.
10. Provide the AV Consultant with all test results, manuals, software, as-built documentation, etc. prior to acceptance testing.
11. Inform the Owner and AV Consultant that the systems are ready for the AV Consultant to perform System Acceptance Testing. The system shall be considered ready for acceptance testing when the following conditions are met:
    a. AV Contractor has pre-tested all systems such that all sub-systems, functions, software, and equipment are debugged and operational.
    b. AV Contractor has supplied the AV Consultant with the written test results and documentation as listed above for all rooms and systems.
    c. AV Contractor has supplied the AV Consultant with closeout (manuals, training materials, and other as-built) documentation revised to reflect comments and/or revisions arising from the review cycles listed elsewhere within this document.
12. Should the systems not be ready for testing by the AV Consultant at the date(s) and time(s) indicated by the AV Contractor, system acceptance testing may be rescheduled at the sole discretion of the AV Consultant. Pay for the labor and expenses of the AV Consultant and other project team members assembled at the project site for the purpose of system acceptance testing for the date(s) of the original scheduled testing plus the labor and expenses of the AV Consultant and other project team members for the rescheduled testing date(s). The labor rate for the AV Consultant shall be a flat rate of $200.00/hour including travel time. Other project team member labor costs shall be at their respective published rates. The PM and/or Owner shall be entitled to deduct any money owed to the Owner, PM, AV Consultant, or other project team members under this contract from any sum which may become due or is payable to the AV Contractor under this Contract for the purposes of satisfying the charges listed above.

D. Final Acceptance Test
1. Testing will be performed with the Owner (or its designees) present to determine that the AV system equipment satisfies the manufacturers' performance specifications and that the installed AV system satisfactorily performs the functions required by this specification. Conduct formal pre-acceptance tests prior to the Owner's acceptance testing to ensure that the performance and functional specifications are satisfied by the installed system and the system is ready for the Owner's acceptance. Verify in the owner's presence that the installed audiovisual system satisfies the performance and functional requirements through formal acceptance testing. Be responsible for staging each room to be tested and shall have sufficient personnel on site to run multiple systems at once (not less than three (3) personnel).

E. Test Equipment
1. Assemble the following test equipment (or equivalent) on site:
    a. Audio and Video cables, terminations, adapters, etc.
    b. Blu-Ray (if applicable)
    c. HDMI/DVI Test Signal Generator
    d. Waveform Monitor
    e. PC/Laptop/Tablet

F. Audio System Testing
1. Absolute Impedances
    a. Set any loudspeaker level controls at zero attenuation. Measure absolute impedance value of each loudspeaker line at 250, 500, 1000, 2000, 4000 Hz without the amplifier connected but with all loudspeakers connected. Impedance must be greater than or equal to the rated load impedance of the respective amplifier. Check the resistance of
        1) lines to all loudspeakers and microphone receptacles with the receptacles open

and short-circuited.

2. Hum and Noise Level
   a. Test overall hum and noise. System noise should be at least 60 dB below the rated power output of each amplifier with the amplifier controls when set for both full output and for optimal signal-to-noise ratio.
3. Parasitic Oscillation and RF Pickup
   a. Set up the system for each specified mode of operation.
   b. Ensure the system is free of spurious oscillation and RF pickup in the absence of any input signal in each mode of operation and with the system driven momentarily to full output at 160 Hz.
4. Buzzes, Rattles, Distortions
   a. Apply high quality music signal to the system. Adjust the sound system to its maximum usable sound pressure level, and verify clipping is not occurring at any system element.
   b. Apply a sinewave sweep from 50 to 5,000 Hz, 6 dB below full amplifier power.
   c. For both the music and sine sweep sources, listen carefully for buzzes, rattles and objectionable distortion.
   d. Correct all causes of such defects. If the artifact is not caused directly by audiovisual system components, promptly notify the architect indicating cause and suggested corrective procedures.
5. Implement any automated emergency system mute functions required by local regulations.
6. Equalize all audio systems for maximum gain before feedback in all room configurations. Adjust all system inputs for consistent operating levels (within 6dB RMS).
7. Within each audio system, ensure all loudspeakers are installed with the same relative polarity and absolute polarity consistent with each input source device.
8. Verify coverage is consistent throughout audience areas. Adhere to ANSI/INFOCOMM standard 1M-2009, Audio Coverage Uniformity in Enclosed Listener Areas. Perform separate tests for each audio system in the project and be responsible for modifying or augmenting systems as required to meet the referenced standards.
9. Verify that audio/video synchronization is maintained for all content sources and destinations.
10. Record all system settings and include in the Systems Operation manuals.

G. Video System Testing
   1. Signal Paths
   2. Utilizing a NTSC color bar generator and waveform analyzer with the video signal set at 100% saturation and 75% amplitude check that the video performance specifications are met at the display devices from all source inputs to all system outputs. Connect the combined waveform monitor/vectorscope to a final output point, e.g. an input to a picture monitor or video projector. Ensure that the test signal is routed to the selected output(s). Level Balance
      a. Adjust all video projection equipment to fill the entire screen area and to produce the best image possible.
      b. Adjust all video sources and displays to produce the best image possible.
      c. Verify that colors appear uniformly on all video displays.
      d. Verify that all pixels operate correctly, consistently meeting or exceeding the manufacturer’s specifications. Replace any equipment with pixel failures (dead or excessively bright pixels).
      e. Record all system settings for inclusion in the Systems Operation manuals.

H. RGBHV System Testing
   1. For all RGBHV inputs, connect the RGBHV output of the signal generator to a floorbox/table/rack connector and select the SMPTE bar with “pluge pulse” signal at the following computer scan rates:
      a. a. 1024 x 768 XGA
      b. b. 1280 x 1024 SXGA
      c. 1366 x 768 WXGA d. 1400 x 1050 SXGA+ e. 1440 x 900 WXGA+ f. 1600 x 1200 UXGA g. 1920 x 1080

d. h. 1080i
e. 1080p
f. 720i
g. 720p

2. Check that the image is correctly displayed at all system outputs including the monitor(s) and/or by the video projector.
3. Repeat items 1 and 2 using Crosshatch, Checkerboard, and H Pattern Signals.

I. Digital Video System Testing
1. For all digital video inputs, connect the output of the digital signal generator to each connection at the following resolutions:
a. 24 MHz Pixel Clock
b. 63.5 MHz Pixel Clock
c. 68 MHz Pixel Clock
d. 79.5 MHz Pixel Clock
e. 109 MHz Pixel Clock
f. 148.5 MHz Pixel Clock
g. 154 MHz Pixel Clock
h. 162 MHz Pixel Clock
i. 173 MHz Pixel Clock
j. 148.5 MHz Pixel Clock k. 1280 x 768p60 3D HDTV
k. 1920 x 1080p24 3D HDTV
l. m. 1920 x 1200p75 Deep Color n. 2560 x 1600p75
m. o. 3840 x 2160p60 p. 4096 x 2160p30
n. q. 4096 x 2160p30 Deep Color

2. Check that the image is correctly displayed at all system outputs including the monitor(s) and/or by the video projector. Display resolution shall be limited only by the manufacturer specified capabilities of the display or source device. Verify that all display resolutions appear correctly for each system source and destination without artifacts, including but not limited to pixel shift, geometric distortion, letterboxing, pillarboxing, and windowboxing.
3. Focus all images and adjust as required to eliminate any stretching, keystone, or other distortion. In no instance shall an image be mapped or shaped to an unusual surface unless explicitly defined in the project documents. Repeat items 1 and 2 with an HDCP compliant source to all outputs simultaneously to verify compliance.
4. Disable CEC for all source HDMI connections to switchers, scalers or other video processors.
5. Configure or disable EDID as required for consistent, error-free operation.

J. Optical Projection Systems
1. All optical projection systems shall meet the following performance standards:
a. The total averaged light output from a projector, in lumens, shall be within ±15% of that specified by the projector manufacturer.
b. The light fall-off from the center of the projected image to all four corners, as measured at the projected image plane, shall not exceed 35%. The light intensity shall be measured at all five positions of the projected image after the projector has been adjusted to provide the light output as specified above.
c. The “corner” locations shall be defined as the four points determined by intersecting lines drawn 5% of the distance in from the focused edges of the image.
d. The light meter used for the above measurements shall be properly calibrated foot-candle (or lux) meter and shall be cosine-corrected.
e. Projectors, lenses, and mirrors shall be solidly mounted and braced so that there will be no observable movement in the image induced by motor vibration or other mechanical operations.

K. Qualification Methods
1. Three methods will be used to qualify the AV system for acceptance.
a. Inspection - A critical observation of qualifying factors, such as quality of workmanship, equipment placement, routing of cables, adequacy of technical documentation, etc., that do not lend themselves to demonstration or measurement.

b. Demonstration - A process of showing by reason or evidence that a given condition clearly satisfies the requirement.
c. Measurement - A process of determining the actual dimension, capacity, or amount of something, by measuring using calibrated standards.

2. Acceptance of the work of this section shall occur after completion of corrections and adjustments required by “Punch List” (as generated during demonstration and acceptance testing of completed installation).
3. Owner reserves the right to use equipment, material and services provided as part of Work of this Section, prior to acceptance, without incurring any obligation to accept any equipment or completed systems until punch list work is complete and systems comply with the contract documents.

3.05 SOURCE QUALITY CONTROL CATEGORY RATED CABLING

A. Factory test F/UTP and UTP and optical fiber cables on reels according to ANSI/TIA-568.2-D and ANSI/TIA-568.3-D.
B. Factory test F/UTP and UTP cables according to ANSI/TIA-568.2-D.
C. Factory test multimode and singlemode optical fiber cables according to ANSI/TIA-526-14-A and ANSI/TIA-568.3-D.
D. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
E. Cable will be considered defective if it does not pass tests and inspections.
F. Prepare test and inspection reports.

3.06 CATEGORY RATED CABLING INSTALLATION OF CABLES

A. Comply with NECA 1.
B. General Requirements for Cabling:
1. Comply with ANSI/TIA-568.2-D and ANSI/TIA-568.3-D.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (762 mm) and not more than 6 inches (152.4 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Cables shall not be painted or exposed to any other building adhesives, paint, coatings, or other foreign agents.
7. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
11. In the communications equipment room, install a 10-foot long service loop on each end of cable.
12. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. F/UTP and UTP Cable Installation:
1. Comply with ANSI/TIA-568.2-D.
2. Do not untwist F/UTP and UTP cables more than 1/4 inch (6.35 mm) from the point of termination to maintain cable geometry.
3. Terminate patch panels and outlets to a pin/pair assignment as directed by owner.

D. F/UTP and UTP Patch Cords
1. Provide modular cords required to connect LAN switches to modular jacks on cross connect panel shall be furnished as part of this solicitation. Quantities should be equal to

the total number of network outlets. At the Patch panel location provide patch cable lengths as needed for a neat installation utilizing vertical wire managers. At the user outlets provide 10 foot (304.8 cm) patch cables for each 8 pin modular connector

E. Horizontal Cable Managers
   1. When more than one horizontal cable manager is used on a rack/cabinet or group of racks/cabinets, use the same make, and style of cable manager on the rack/cabinet or racks/cabinets.
   2. The color of the racks/cabinets and cable managers must match.
   3. Attach horizontal cable managers to the rack/cabinet with four screws according to the manufacturer's installation instructions. Each cable manager should be centered within the allocated rack-mount space (RMU).
   4. Horizontal managers will be located so that the number of ports (cables) they support will not exceed the cable fill capacity of the cable manager.
   5. Covers should be attached to the cable manager and in the closed position after cabling is complete.

3.07 FIRESTOPPING CATEGORY RATED CABLING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."
B. General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
C. Install EZ Path or EMT sleeve where horizontal cables penetrate a fire rated wall.
D. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.
E. Comply with ANSI/TIA-569-E, "Firestopping."
F. Comply with BICSI TDMM, "Firestopping Systems" Article.
G. Any penetrations created for the passage of telecommunications which remains vacant at the completion of the installation shall be fire-stopped.

3.08 NON-RATED CABLE PASS-THRU SLEEVES

A. Comply with requirements in Division 07 Section "Penetration Firestopping."
B. General: Install through-penetration systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
C. EZ Path® Series 44 NEZ Smoke and Acoustical Pathway per manufactures instructions
D. EZ Path® Series 33NEZ Smoke and Acoustical Pathway per manufactures instructions
E. Any EMT non-rated wall penetrations created for the passage of telecommunications shall have the annular space filled with mineral wool and Smoke and sound acoustical sealant.
F. Any non-rated EMT wall penetrations created for the passage of telecommunications which remains vacant at the completion of the installation shall be filled with mineral or ceramic fiber stuffing insulation and smoke/sound acoustical sealant.

3.09 GROUNDING CATEGORY RATED CABLING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
B. Comply with requirements in division 27 05 26 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
C. Comply with ANSI-J-STD-607-C.
D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.10 FIELD QUALITY CONTROL CATEGORY RATED CABLING

A. Perform tests and inspections.
B. Tests and Inspections:
   1. Visually inspect F/UTP and UTP, multi-pair copper and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with ANSI/TIA-568.2-D and ANSI/TIA-568.3-D.
   2. Visually confirm cable category marking of outlets, cover plates, outlet/connectors, and patch panels.
   3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and

patch cords, and labeling of all components.

4. Test F/UTP and UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    a. Test instruments shall meet or exceed applicable requirements in ANSI/TIA-568.2D. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
5. Optical Fiber Cable Tests:
    a. Test instruments shall meet or exceed applicable requirements in ANSI/TIA-568.3-D. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:
        1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to ANSI/TIA-526-14-A, Method B, One Reference Jumper.
        2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in ANSI/TIA-568.3-D.
    c. Optical Time Domain Reflectometer (OTDR) Tests:
        1) Provide OTDR testing for all installed optical fiber links, including all backbone and horizontal links.
        2) Submit OTDR test results to owner upon completion of system installation.
6. F/UTP and UTP Performance Tests:
    a. Test for each outlet. Perform the following tests according to ANSI/TIA-568.2-D:
        1) Wire map.
        2) Length (physical vs. electrical, and length requirements).
        3) Insertion loss.
        4) Near-end crosstalk (NEXT) loss.
        5) Power sum near-end crosstalk (PSNEXT) loss.
        6) Equal-level far-end crosstalk (ELFEXT).
        7) Power sum equal-level far-end crosstalk (PSELFEXT).
        8) Return loss.
        9) Propagation delay.
        10) Delay skew.
7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to ANSI/TIA-568.3-D.
8. Final Verification Tests: Perform verification tests for F/UTP and UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
    a. Data Tests: Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 inch (256.54 mm) BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
    1. End-to-end cabling will be considered defective if it does not pass tests and inspections.

DIVISION 27 30 00 – MULTIMEDIA SYSTEMS FLOORBOXES

PART 1 - GENERAL

1.01 REFERENCE STANDARDS

1.02 SUMMARY

A. Section includes:
   1. Multimedia Systems Floorboxes

1.03 PERFORMANCE REQUIREMENTS

A. General: Floor boxes provide interface between power, audiovisual, and telecommunications cabling in concrete floors and decks at workstations or at activation locations requiring power, audiovisual, or communication device outlets.
   1. ADA Compliance: Flush-mounted floor device outlets shall not create tripping hazards.

B. Floor Mounted Connector Assembly: Watertight, rubber cable pass thru gasketed door and cover assembly, utilizing basket and connector mounting panel inserts. Customize cover/door opening so that cable pass-thru will accommodate the bundle of AV cabling specified, while maintaining the ability to fully close with cables connected.

C. Labeling: Floor boxes shall bear the “cULus mark” issued by UL for units complying with both US and Canadian Standards.

D. Standards: Comply with the following:
   1. UL 514A
   2. National Electrical Code

1.04 SUBMITTALS

A. Related Sections
   1. Comply with requirements of *Division 01 30 00*, “Submittal Procedures.”

B. Submittal Data
   1. Submittal data is to be submitted as a complete, single digital file. All documents shall be clearly legible. Each submittal shall contain the below in the following order:
      a. Cover Sheet
         1) Include name of supplying contractor and project name.
         2) Include submittal and revision number.
      b. Detailed Bill of Materials
         1) Include a listing of: component quantities, equipment manufacturers, model numbers, descriptions of each component being supplied, and the specification paragraphs or drawing sheets that correspond to each product.
         2) The bill of materials shall be index referenced within the PDF file so that each product name is clickable, linked to the first page of the corresponding product data.
         3) Failure to provide this information will result in the rejection of submittals.
      c. Product Data
         1) Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product.
         2) Photocopy duplications of the manufacturer’s original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures.
         3) If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight. All optional components and selections shall be clearly indicated.
         4) Indicate floor box models, trim, finish, and accessories.
   2. Informational Submittals
      a. Submit Manufacturer’s installation instructions.
   3. Partial submittals, or submittals comprised of multiple PDF files, will not be accepted.

C. Photographs
   1. Submit photographs of each placed floorbox with associated conduit prior to slab pour.

D. Shop Drawings
   1. Prior to fabrication submit contractor-generated drawings for approval for all supplied

systems. These drawings shall include, but are not limited to, the following:
    a. Title Sheet with sheet index and symbols legend
    b. All panels, plates, and designation strips, including connectivity, layout, labeling, and details relating to terminology, engraving, finish and color
    c. All unusual equipment modifications
    d. Equipment location drawings, dimensioned to column lines
    e. Include detailed elevation drawings, showing conduit runs and associated box knockout locations
    f. Furniture coordination drawings, depicting planned cable pathway to furniture raceway or outlets, where applicable
  2. Drawings should be at project standard scale and clearly legible.
  3. Resubmission of contract drawings does not constitute a complete shop drawings submittal and is unacceptable. Such submittals will be rejected.

E. Form
  1. Submit all materials for review as described above, specifically referenced to the specification paragraph number (where applicable).
    a. Submit all drawings on sheets of one size, preferably the project standard size.
    b. On submittal drawings, maintain 3/32” minimum lettering height. Submittals with text less than 1/16” in height may be rejected.
  2. Partial Submittals may be rejected. If submitted individually and each in its entirety, the following submittals shall not be considered partial:
    a. Personnel
    b. Milestones
    c. Conduit Verification Statement and Notifications
    d. Rigging and Mounting Drawings
    e. As-Built Documentation
  3. Product Data and shop drawings must be submitted together in order to be reviewed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:
  1. Legrand/Wiremold
  2. Approved equal

B. Multimedia Systems Floorbox:
  1. In-slab: EFB8S-OG
  2. Raised floor: EFB8S
  3. Fire classified: EFB8S-FC

2.02 MATERIALS

A. Door and Cover: Not lighter than 11-gauge steel with integral, self-trimming carpet trim ring. Mount trim ring flush with floor covering. Secure with security socket head screws.
  1. Finish: Satin black coating
  2. Trim: Door, cover, and integral trim ring shall have radiused corners.

B. Device Plates
  1. Provide device plates as detailed on drawings.
  2. Provide blank plates for all unused openings.

C. In-slab Boxes
  1. 11-gauge steel, 15 13/16 inches (20.64 mm) by 12 3/4 inches (19.05 mm) by 6 1/16 inches (1.59 mm) deep
  2. Mount on manufacturer’s backbox.

D. Raised floor Boxes
  1. 11-gauge steel, 15 13/16 inches (20.64 mm) by 12 3/4 inches (19.05 mm) by 6 1/16 inches (1.59 mm) deep
  2. Provide toggle clamps to allow box to be secured to raised floors.

E. Fire classified floor Boxes
  1. 11-gauge steel, 15 13/16 inches (20.64 mm) by 12 3/4 inches (19.05 mm) by 6 1/16 inches

(1.59 mm) deep
2. Provide fire-rated backbox and install per manufacturer's instructions.
3. All boxes shall maintain a minimum of 1 hour of fire rating.

F. Provide pull strings in each conduit at floor box location. Coordinate conduit to box knockout location with telecommunication cabling and audiovisual systems requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. The minimum concrete pour depth shall be 7 inches (177.8 mm) less decking. For pour depths less than 7 inches, provide structural bracing and firestopping as necessary.

B. With Installer present, verify that manufacturer's requirements for floor opening and infrastructure conditions have been satisfactorily met. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Arrange for jobsite approval of the equipment prior to installation.

B. Verify exact locations of floorbox installation.

C. Coordinate all box locations with furniture onsite prior to installation.

3.03 INSTALLATION

A. Install equipment in compliance with approved shop drawings and manufacturer's installation instructions.

B. Install in position and relationship to adjoining work indicated, securely anchored to supporting structure, sealed and finished, and in a manner which produces a level box with square, plumb, and straight edges.

C. Coordinate installation with floor covering to finish each floor box. Install floor covering with oversized cable management pop-up pass-thru in top, matching surrounding floor covering in cover insert.

3.04 ADJUSTING

A. Adjust door/cover for proper operation.

3.05 PROTECTION

A. Protect installed equipment in original undamaged condition until Substantial Completion. Replace damaged components for units that cannot be repaired prior to Substantial Completion.

DIVISION 28 16 00 – SECURITY SYSTEMS

GENERAL

The MSCS School Security Department has an ongoing contract for security monitoring of our schools and shall be contacted for input on any security system.
The equipment installed in the building now uses a line-seizure device on a phone line to provide the connection to the monitoring contractor. The security system will be provided with a network connection point at the coordinated panel location for alerting and management. The security system vendor should be put in contact with TIS in order to identify this location and coordinate the connection. Alarm companies should always try to design the installation of the central control panel into the IDF A space for ease of conductivity and security of the panels.

Installation should follow the MSCS Low Voltage Standards (version adopted at the time of contract signing). It is imperative that this company be contacted and made to understand the importance of schedule and proper installation, i.e. no exposed conduit or wiring.

Security provisions to be provided by the General Contractor shall include electrical outlets as well as rough-in boxes for contracted security monitoring services to install their equipment after completion of the building. Provisions for serving the sensing units to be mounted throughout the building shall be provided. Coordinate with the security monitoring contractor during design. The designer is to determine whether the use of plenum rated cable will be required and advise the Owner.

All exposed Security System wiring to be installed in conduit.

DIVISION 28 30 00 – FIRE ALARM SYSTEMS

PART 1 GENERAL

- The facility shall have a monitored fire alarm system as required by governing codes, including requirements for accessibility. The system shall incorporate the two-way communication capabilities of the required intercom (or telephone) system to satisfy Fire Code requirements to allow elimination of corridor pull stations. Electrical backup for both the fire alarm and intercom (or telephones) shall be by battery, plus integral generator-supplied power behind that. Portable fire extinguishers shall be provided throughout the building as required by codes. Note that fire codes require all spaces used by first grade and younger students (including auxiliary spaces such as P.E., cafeteria, media center, music, art, etc.) to be on the ground floor.
- Install a new commercial-grade fire alarm system in accordance with NFPA 72, local building codes, and AHJ (Authority Having Jurisdiction) requirements. The system will provide early detection, occupant notification, and integration with emergency response protocols.
- MSCS will mandate a Design-Build delivery method to be used in construction where a single entity—known as the design-builder—is responsible for both the design and construction of the New Fire Alarm Protection project.
- Single Point of Responsibility: The owner contracts with one entity for both design and construction, simplifying communication and accountability.
- Integrated Team: Designers and builders work collaboratively from the beginning, which can lead to better coordination and innovation.
- Faster Delivery: Because design and construction phases can overlap, projects often finish sooner.
- Cost Efficiency: Early collaboration can help control costs and reduce change orders

Any building built after 2002 is required by the Life Safety Code to have the fire alarm monitored by an approved central station. Any school that has a fire pump is required to have the signals from that pump transferred to a central station as well.

1. Include in the specifications to provide in the bid price, the cost to monitor, test and inspect for one (1) year. The design and installation of the fire alarm system shall implement the following criteria but not be limited to:
2. The new systems shall be tested with all deficiencies corrected prior to requesting a final AHJ inspection.
3. All smoke detectors shall be labeled with the appropriate address for identification and troubleshooting purposes. Label shall be visible from the floor below or immediately adjacent to the device.
4. Ground fire alarm control unit and associated circuits shall comply with IEEE 1100. Install a ground wire from the main service ground to the fire alarm control unit. Ground shielded cables at the control panel location only. Insulate shield at device location.
5. Provide and install plenum rated cabling only, no exceptions!
6. Contractor shall install J-Hooks or bridal rings to support cabling above suspended ceilings at every 3’ to 4’ intervals.
7. Wall penetrations shall be sleeved with conduit, bushed on both ends and fire caulked at both ends.
8. Grout space between new sleeve and CMU wall after sleeve installation. If the wall is sheetrock, the space between the new sleeve and sheetrock must be spackled with sheetrock patching compound. Both sides of wall sleeve must be sealed.
9. The existing fire alarm system must remain operable while the new system is being installed.
10. The installation supervisor shall be on the job site during the entire installation. The installation supervisor shall maintain marked up copies of the drawings at the job site showing as-built conditions. These drawings shall be updated daily and available for Owner review.
11. After the new fire alarm system has been installed and approved by all Authorities Having Jurisdiction, the Contractor shall demolish and remove the old system. Demolition shall include the removal of the fire alarm panel, remote annunciator panel, power supplies, system cabling, associated raceways, devices and enclosures. Prior to demolition, consult with MSCS project manager to determine if there is any MSCS wanted salvageable old fire alarm system equipment. Any identified equipment shall be delivered to the MSCS Maintenance Warehouse located at 1364 Farmville Rd. Memphis TN 38122.
12. After existing system demolition, the Contractor shall replace any suspended ceiling tiles that contained pre-existing devices or any ceiling tiles that are damaged as a result of the installation process.
13. After existing system demolition, the Contractor shall install stainless steel cover plates over all abandoned

fire alarm recessed receptacle boxes.

14. The Contractor shall perform touch-up painting below any suspended ceilings from any voids that arise from the demolition process. This includes, but not limited to, pre-existing wall mounted enclosures, raceways, power supplies or fire alarm devices.
15. Upon completion, the Contractor shall supply the MSCS project manager with a minimum of four keys to new fire alarm system cabinet.
16. After new fire alarm system installation, the Contractor shall conduct a training session with school staff and other MSCS personnel on system operations. Topics covered shall include annunciator panel location(s), monitoring company contact information, voice evacuation system operation, test mode, silencing and supervisory location points.
17. All exposed Fire Alarm wiring to be installed in conduit.
18. The Contractor shall be responsible for paying all necessary costs associated with having elevator, sprinkler, fire suppression and HVAC companies/personnel present for testing purposes related to obtaining a successful final Code inspection.

System Design

- Conduct site survey and risk assessment.
- Develop fire alarm system layout including:
- Existing System must be monitored during installation process of New Fire Alarm system in all cases.
- Demo Existing System, Patch, Paint, fire Caulk all penetrations and replace all damaged items/materials once new system is installed and inspected for owner acceptance.
- Smoke detectors
- Heat detectors
- Pull stations
- Notification appliances (horns, strobes, speakers)
- Fire alarm control panel (FACP)
- Annunciator panels
- Smoke detectors (including duct-type), heat detectors, flame detectors.
- Dry-contact relays for fan shutdown and damper control.
- Supervisory signals for duct detectors.
- Install duct-type smoke detectors in HVAC return and supply ducts.
- Program detectors to initiate supervisory or alarm signals.
- Interface fire alarm system with HVAC controls to:
- Shut down air handling units.
- Close fire/smoke dampers.
- Prevent smoke migration across zones.
- Ensure all control wiring is monitored for integrity or designed fail-safe.
- Coordinate with electrical, architectural, and life safety plans.

Equipment & Materials

- UL-listed fire alarm control panel (addressable or conventional)
- Backup batteries and power supplies
- Initiating devices (smoke/heat detectors, manual pull stations)
- Notification devices (strobes, horns, speakers)
- Wiring and conduit per NEC standards
- Surge protection and grounding

Installation

- Install all devices per approved plans and manufacturer specifications.
- Route and terminate wiring in compliance with NEC and NFPA 70.
- Mount and connect FACP and remote annunciators.
- Label all devices and circuits clearly.

Integration

- Connect fire alarm system to:
- Building sprinkler system (flow/tamper switches)
- Elevator recall
- HVAC shutdown

- Emergency lighting and exit signs (if applicable)
- Central monitoring station (if required)

Testing & Commissioning

- Perform pre-functional testing of all devices.
- Conduct full system test witnessed by AHJ or third-party inspector.
- Verify signal transmission to monitoring station.
- Provide test documentation and as-built drawings.
- Include programmable logic or firmware software updates

Training & Documentation

- Train building staff on system operation and emergency procedures.
- Provide Electronic and Hard copied manuals, warranty information, and maintenance schedule.

Warranty & Maintenance

- Provide 1-year warranty on labor and materials.
- 1 hour responds time for emergency calls.
- Optional ongoing maintenance and monitoring services. (alternate #1)
  - Fire alarm systems must be inspected routinely to ensure functionality and compliance.
  - Monthly and annual tests are often required.
  - Keep manuals, inspection records, and maintenance logs organized and accessible.
  - Include battery-backed exit signs and emergency lights that are activated during power outages.
  - Suppression and foam systems should be tested monthly, quarterly, and annually as per regulations.

1.01 SECTION INCLUDES

A. Fire alarm system design and installation, including manual stations, detectors, signal equipment, controls, and devices, and all required components, wiring, and conduit.
B. Transmitters for communication with supervising station.
C. Circuits from protected premises to supervising station, including conduit.
D. Maintenance of fire alarm system under contract for specified warranty period.

1.02 SYSTEM DESCRIPTION

A. General: Noncoded, intelligent addressable system with manual and automatic alarm initation; and multiplexed signal transmission dedicated to fire alarm service only, automatic dialer and provisions for future connection to network system.

1.03 RELATED REQUIREMENTS

A. *Division 08 33 23* - Overhead Coiling Doors: Coiling fire doors to be released by fire alarm system.
B. *Division 08 71 00* - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.
C. *Division 21 13 00* - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.
D. *Division 23 33 00* - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

1.04 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
E. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.
F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Proposal Documents: Submit the following with cost/time proposal:

1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
3. Certification by Contractor that the system design will comply with Contract Documents.
4. Proposed maintenance contract.

C. Drawings must be prepared using AutoCAD Release 10 or later.
1. Owner will provide floor plan drawings for Contractor's use; verify all dimensions on Owner-provided drawings.

D. Evidence of designer qualifications.

E. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
1. Copy (if any) of list of data required by authority having jurisdiction.
2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
4. System zone boundaries and interfaces to fire safety systems.
5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
7. List of all devices on each signaling line circuit, with spare capacity indicated.
8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
9. Description of power supplies; if secondary power is by battery, include calculations demonstrating adequate battery power.
10. Detailed drawing of graphic annunciator(s).
11. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
12. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
13. Certification by Contractor that the system design complies with Contract Documents.

F. Coordination Drawings: Plans, sections, and elevations drawn to scale and coordinating installation of smoke detectors in ducts and access to them. Show the following near each duct smoke provision of detector installation:
1. Size and location of ducts, including lining.
2. Size and location of piping.
3. Size and arrangement of structural elements.
4. Size and location of duct smoke detector, including air-sampling elements.

G. Evidence of installer qualifications.

H. Evidence of instructor qualifications; training lesson plan outline.

I. Evidence of maintenance contractor qualifications, if different from installer.

J. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
2. Submit documentation of satisfactory inspections and tests.
3. Submit NFPA 72 "Inspection and Test Form," filled out.

K. Operating and Maintenance Data: See Section 01 7800 for additional requirements; have one set available during closeout demonstration:
1. Original copy of NFPA 72 with portions that are not relevant to this project neatly crossed out by hand; label with project name and date.
2. Complete set of specified design documents, as approved by authority having jurisdiction.

3. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
4. Contact information for firm that will be providing contract maintenance and trouble call-back service.
5. List of recommended spare parts, tools, and instruments for testing.
6. Replacement parts list with current prices, and source of supply.
7. Detailed troubleshooting guide and large scale input/output matrix.
8. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
9. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

L. Project Record Documents: Have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
2. "As installed" wiring and schematic diagrams, with final terminal identifications.
3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

M. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
3. Certificate of Occupancy.
4. Maintenance contract.
5. Report on training results.

N. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.
1. See *Division 01 60 00* - Product Requirements, for additional provisions.
2. In addition to the items in quantities indicated in PART 2, furnish the following:
   a. All tools, software, and documentation necessary to modify the fire alarm system using Owner's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.
   b. Two sets, saved on a flash drive, of all software not resident in read-only-memory.
   c. Extra Fuses: Two for each installed fuse; store inside applicable control cabinet.

O. Spare Parts: Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but not less than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than one unit.
3. Smoke Detectors, Fire Detectors, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than one unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than one unit of each type.
5. Keys and Tools: One extra set for access to locked and tamper proofed components.

P. Operating Instructions: For mounting at the FACP.

Q. Submissions to Authorities Having Jurisdiction: In addition to distribution requirements for Submittals specified in Division 1 Section "Submittals," make an identical submission to authorities having jurisdiction. Include copies of annotated Contract Drawings as needed

to depict component locations to facilitate review. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.

1.06 QUALITY ASSURANCE

Copies of Design Criteria Documents: Maintain at the project site for the duration of the project, bound together, an original copy of NFPA 72, the relevant portions of applicable codes, and instructions and guidelines of authorities having jurisdiction; deliver to Owner upon completion.

A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer , with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
   1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
   2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
   3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
   4. Contract maintenance office located within 50 miles (80 km) of project site.
   5. Certified in the State in which the Project is located as fire alarm installer.

C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

1.02 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.

B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

1.03 SESMIC REQUIREMENTS

A. Provide Seismic tested equipment as follows:
   1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the International Building Code (IBC)

B. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
   1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil/structural engineer in the state of the project. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
   2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

C. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Alarm Control Units - Basis of Design: Simplex, a Tyco Business; www.simplex-fire.com..

B. Acceptable manufacturers:
   1. Honeywell: FireLite
   2. Silent Knight: Notifier: Gamewell-FCI

C. Fire Units: Provided their products meet or exceed the performance of the basis of design product, products of other manufacturers are acceptable.

1. Provide control units made by the same manufacturer.

D. Initiating Devices and Notification Appliances:
   1. Same manufacturer as control units.
   2. Provide initiating devices and notification appliances made by the same manufacturer, where possible.

E. Substitutions: See *Division 01 25 00* Product Substitutions.
   1. For other acceptable manufacturers of control units specified, submit product data showing equivalent features and compliance with Contract Documents.
   2. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with Contract Documents.

2.02 FIRE ALARM SYSTEM

A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
   1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
   2. Protected Premises: Entire building shown on drawings.
   3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
      a. ADA Standards for Accessible Design.
      b. The requirements of the State Fire Marshal.
      c. The requirements of the local authority having jurisdiction.
      d. Applicable local codes.
      e. NFPA 101.
      f. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.

B. Spare Capacity:
   1. Initiating Device Circuits: Minimum 25 percent spare capacity.
   2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
   3. Speaker Amplifiers: Minimum 25 percent spare capacity.
   4. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.

C. Power Sources:
   1. Primary: Dedicated branch circuits of the facility power distribution system.
   2. Secondary: Storage batteries.
   3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
   4. Each Computer System: Provide uninterruptible power supply (UPS).

2.03 FIRE SAFETY SYSTEMS INTERFACES

A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
   1. Sprinkler water control valves.
   2. Dry-pipe sprinkler system pressure.
   3. Dry-pipe sprinkler valve room low temperature.
   4. Fire pump(s).
   5. Elevator shut-down control circuits.
   6. Chute interlocks and controls.
   7. Exhaust Hood Suppression controls.

B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
   1. Sprinkler water flow.
   2. Total flooding suppression system activation.
   3. Kitchen hood suppression activation; also disconnect fuel source from cooking equipment.
   4. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
   5. Generator room heat detector.
   6. Duct smoke detectors.
   7. Pull stations.

C. Elevators:
   1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.
   2. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.
   3. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.
D. HVAC:
   1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.
E. Doors:
   1. Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 08 7100.
   2. Electromagnetic Door Locks on Egress Doors: Unlock upon activation of any alarm initiating device or suppression system in smoke zone that doors serve as egress from. Refer to Section 08 7100.
   3. Overhead Coiling Fire Doors: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 08 3323.

2.04 COMPONENTS

A. General:
   1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
   2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
B. Fire Alarm Control Units, Initiating Devices, and Notification Appliances: Analog, addressable type; listed by Underwriters Laboratories or other testing agency acceptable to authority having jurisdiction.
C. Master Control Unit: As specified for Basis of Design above, or equivalent.
D. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.
   1. Equipment Connected to Alternating Current Circuits: Maximum let through voltage of 350 V(ac), line-to-neutral, and 350 V(ac), line-to-line; do not use fuses.
   2. Initiating Device Circuits, Notification Appliance Circuits, and Communications Circuits: Provide surge protection at each point where circuit exits or enters a building; rated to protect applicable equipment; for 24 V(dc) maximum dc clamping voltage of 36 V(dc), line-to-ground, and 72 V(dc), line-to-line.
   3. Signaling Line Circuits: Provide surge protection at each point where circuit exits or enters a building, rated to protect applicable equipment.
E. Locks and Keys: Deliver keys to Owner.
   1. Provide the same standard lock and key for each key operated switch and lockable panel and cabinet; provide 5 keys of each type
   2. Provide a different standard lock and key for each key operated alarm initiating device; provide 25 keys of each type.
F. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
   1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
   2. Provide one for each control unit where operations are to be performed.
   3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
   4. Provide extra copy with operation and maintenance data submittal.

G. Storage Cabinet for Spare Parts and Tools: Steel with baked enamel finish, size appropriate to quantity of parts and tools.
   1. Padlock eye and hasp for lock furnished by Owner.
   2. Locate as directed by Owner.

2.05 FUNCTIONAL DESCRIPTION OF SYSTEM

A. System Supervision: Automatically detect and report open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.

B. Priority of Signals: Automatic alarm response functions resulting from an alarm signal from one device are not altered by subsequent alarm, supervisory, or trouble signals. An alarm signal is the highest priority. Supervisory and trouble signals have second- and third-level priority. Higher-priority signals take precedence over signals of lower-priority, even when the lower-priority condition occurs first. Annunciate and display all alarm, supervisory, and trouble signals regardless of priority or order received.

C. System Reset: System is manually resettable from the FACP after initiating devices are restored to normal.

D. Transmission to Remote Alarm Receiving Station: Automatically route alarm, supervisory, and trouble signals to a remote alarm station by means of a digital alarm communicator transmitter or telephone dialer system to UL listed central station service. Provide interfacing equipment and devices as required.

E. Loss of primary power at the FACP initiates a trouble signal at the FACP and the annunciator. An emergency power light is illuminated at both locations when the system is operating on the secondary power supply.
   1. Notification-appliance operation.
   2. Identification at the FACP and the remote annunciator of the device originating the alarm.
   3. Transmission of an alarm signal to the remote alarm receiving station.
   4. Unlocking of electric door locks in designated egress paths.
   5. Release of fire and smoke doors held open by magnetic door holders.
   6. Shutdown of fans and other air-handling equipment serving zone when alarm was initiated.
   7. Closing of smoke dampers in air ducts of system serving zone where alarm was initiated.
   8. Recording of the event in the system memory.
   9. Recording of the event by the system printer.

F. Alarm Silencing, System Reset and Indication: Controlled by switches in the FACP and the remote annunciator.
   1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
   2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
   3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

G. Water-flow alarm switch operation initiates the following:
   1. Notification-appliance operation.
   2. Flashing of the device location-indicating light for the device that has operated.

H. Operating a heat detector in the elevator shaft shuts down elevator power by operating a shunt trip in a circuit breaker feeding the elevator.

I. Water-flow alarm for connection to sprinkler in an elevator shaft and elevator machine room shuts down elevators associated with the location without time delay.
   1. A field-mounted relay actuated by the fire detector or the FACP closes the shunt trip circuit and operates building notification appliances and annunciator.

J. Smoke detectors with alarm verification initiates the following:
   1. Audible and visible indication of an "alarm verification" signal at the FACP.
   2. Activation of a listed and approved "alarm verification" sequence at the FACP and the detector.
   3. Recording of the event by the system printer.
   4. General alarm if the alarm is verified.
   5. Cancellation of the FACP indication and system reset if the alarm is not verified.

K. Sprinkler valve-tamper switch operation initiates the following:
   1. A supervisory, audible, and visible "valve-tamper" signal indication at the FACP and the annunciator.
   2. Flashing of the device location-indicating light for the device that has operated.
   3. Recording of the event by the system printer.

4. Transmission of supervisory signal to remote alarm receiving station.

L. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system initiates the following:
   1. A supervisory, audible, and visible "sprinkler trouble" signal indication at the FACP and the annunciator.
   2. Flashing of the device location-indicating light for the device that has operated.
   3. Recording of the event by the system printer.
   4. Transmission of trouble signal to remote central station.

M. Remote Detector Sensitivity Adjustment: Manipulation of controls at the FACP causes the selection of specific addressable smoke detectors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings. Same controls can be used to program repetitive, scheduled, automated changes in sensitivity of specific detectors. Sensitivity adjustments and sensitivity-adjustment schedule changes are recorded in system memory and are printed out by the system printer.

N. Removal of an alarm-initiating device or a notification appliance initiates the following:
   1. A "trouble" signal indication at the FACP and the annunciator for the device or zone involved.
   2. Recording of the event by the system printer.
   3. Transmission of trouble signal to remote alarm receiving station.

O. Printout of Events: On receipt of the signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble), and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including the same information for device, location, date, and time. Commands initiate the printout of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

P. FACP Alphanumeric Display: Plain-English-language descriptions of alarm, supervisory, and trouble events; and addresses and locations of alarm-initiating or supervisory devices originating the report. Display monitoring actions, system and component status, system commands, programming information, and data from the system's historical memory.

2.06 MANUAL PULL STATIONS

A. Description: Fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color.
   1. Single-action mechanism initiates an alarm.
   2. Double-action mechanism requires two actions, such as a push and a pull, to initiate an alarm.
   3. Station Reset: Key or wrench operated; double pole, double throw; switch rated for the voltage and current at which it operates.
   4. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false alarm operation.
   5. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.
   6. Integral Addressable Module: Arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.

2.07 SMOKE DETECTORS

A. General: Include the following features:
   1. Operating Voltage: 24-V dc, nominal.
   2. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   3. Plug-in Arrangement: Detector and associated electronic components are mounted in a module that connects in a tamper-resistant manner to a fixed base with a twist-locking plug connection. Terminals in the fixed base accept building wiring.
   4. Integral Visual-Indicating Light: LED type. Indicates detector has operated.
   5. Sensitivity: Can be tested and adjusted in-place after installation.
   6. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

7. Remote Controllability: Unless otherwise indicated, detectors are analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

B. Photoelectric Smoke Detectors: Include the following features:
   1. Sensor: LED or infrared light source with matching silicon-cell receiver.
   2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
   3. Integral Thermal Detector: Fixed-temperature type with 135 deg F (57 deg C) setting.

C. Ionization Detector: Include the following features:
   1. Responsive to both visible and invisible products of combustion.
   2. Self-compensating for changes in environmental conditions.

D. Remote Air-Sampling Detector System: Includes air-sampling pipe network, a laser-based photoelectric detector, a sample transport fan, and a control unit.
   1. Pipe Network: Electrical metallic tubing connects control unit with designated sampling holes.
   2. Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of three preset values.
   3. Sample Transport Fan: Centrifugal type, creating a minimum static of 0.05 inches (1.3 mm) of water at all sampling ports.
   4. Control Unit: Single or multizone unit as indicated. Provides same system power supply, supervision, and alarm features as specified for the central FACP plus separate trouble indication for airflow and detector problems.
   5. Signals to the Central FACP: Any type of local system trouble is reported to the central FACP as a composite "trouble" signal. Alarms on each system zone are individually reported to the central FACP as separately identified zones.

E. Duct Smoke Detector: Ionization type.
   1. Sampling Tube: Design and dimensions as recommended by the manufacturer for the specific duct size, air velocity, and installation conditions where applied.
   2. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.08 OTHER DETECTORS

A. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or rate of rise of temperature that exceeds 15 deg F (8.3 deg C) per minute, unless otherwise indicated.
   1. Mounting: Adapter plate for outlet box mounting.
   2. Mounting: Plug-in base, interchangeable with smoke detector bases.
   3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

B. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
   1. Mounting: Adapter plate for outlet box mounting.
   2. Mounting: Plug-in base, interchangeable with smoke detector bases.
   3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.09 NOTIFICATION APPLIANCES

A. Description: Equip for mounting as indicated and have screw terminals for system connections.
   1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns produce a sound-pressure level of 90 dB, measured 10 feet (3 m) from the horn.

C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971 with clear or nominal white polycarbonate lens. Mount lens on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
   1. Rated Light Output: 15 candela in corridors, 30 feet on centers or in rooms no greater than 20’x20’, 75 candela for rooms greater that 20’x20’ but less than 55’x55’ and 110 candela for larger spaces.

2. Strobe Leads: Factory connected to screw terminals.
3. All strobes shall be synchronized together.

2.10 REMOTE DEVICE LOCATION-INDICATING LIGHTS AND IDENTIFICATION PLATES

A. Description: LED indicating light near each smoke detector that may not be readily visible, and each sprinkler water-flow switch and valve-tamper switch. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.11 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate.
   1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
   2. Wall-Mounted Units: Flush mounted, unless otherwise indicated.
   3. Rating: 24-V ac or dc.
   4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.12 REMOTE ANNUNCIATOR

A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, reset, and test.
   1. Mounting: Flush cabinet, NEMA 250, Class 1.
   2. Mounting: Surface cabinet, NEMA 250, Class 1.

B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.13 EMERGENCY POWER SUPPLY

A. General: Components include battery, charger, and an automatic transfer switch.
   1. Battery to be sealed Lead-Calcium.

B. Battery Capacity: Comply with NFPA 72.
   1. Magnetic door holders are not served by emergency power. Magnetic door holders are released when normal power fails.

C. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining batteries at full charge. If batteries are fully discharged, the charger recharges them completely within four hours. Charger output is supervised as part of system power supply supervision.

D. Integral Automatic Transfer Switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

2.14 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a multiplex system address for listed fire and sprinkler alarm-initiating devices with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to the elevator controller to initiate elevator recall or to a circuit-breaker shunt trip for power shutdown.

2.15 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Listed and labeled under UL 864 and NFPA 72.

B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP panel, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising two lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.
D. Self Test: Conducted automatically every 24 hours with report transmitted to central station.

2.16 GUARDS FOR PHYSICAL PROTECTION

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
   1. Factory fabricated and furnished by the manufacturer of the device.
   2. Finish: Paint of color to match the protected device.

2.17 WIRE

A. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
   1. Low-Voltage Circuits: No. 16 AWG, minimum.
   2. Line-Voltage Circuits: No. 12 AWG, minimum.
B. Power-Limited Circuits: NFPA 70, Types FPL, FPLR, or FPLP, as recommended by manufacturer.

2.18 VOICE CONTROL PANEL

A. General
   1. Furnish a voice control panel complete with amplifiers, pre-recorded digital voice evacuation announcement, battery back-up and supervisory signals. Voice control panel shall provide pre-recorded announcement to Chapel auditorium, cafeteria and gymnasium, in accordance with NFPA 101. Amplifier quantity and size shall be as required to obtain sound levels required by NFPA. An "All Clear" announcement shall be broadcast when it is safe to re-enter building. Each amplifier output circuit shall be supervised through the fire alarm system for open and short circuit conditions.
   2. Battery backup shall be provided to operate voice evacuation system for 24 hours under maximum quiescent load followed by 2 hours of operation under fire or other emergency condition. Fifteen minutes of evacuation alarm operation at maximum connected load shall be considered equivalent to 2 hours of emergency operation.
B. Fire Alarm Speaker/Strobes
   1. Fire alarm speaker/strobe units with 110 candela strobe rating. These combination units shall be UL listed to Standards 1971 and 1480 and feature wattage taps of 1/4, 1/2, 1, and 2 watts. Speaker shall be capable of 88 DBA output at 10' when driven with a 1000 hz signal.
   2. Furnish and install where noted voice evacuation announcement speakers 7-1/2" round ceiling mounted style with multi-power taps.
      a. Furnish and install in Auditorium/Assembly, voice evacuation speaker/horns with multi-power taps rated up to 5 watts. Speakers shall be surface mounted to beam face and shall be adjusted to project towards walls. Speaker quantity shall be as required to provide NFPA sound level requirements and must meet NFPA intelligibility requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.
B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
C. Obtain Owner's approval of locations of devices, before installation.
D. Install instruction cards and labels.

3.02 EQUIPMENT INSTALLATION

A. Connect the FACP with a disconnect switch with lockable handle or cover.
B. Manual Pull Stations: Mount semi flush in recessed back boxes.
C. Water-Flow Detectors and Valve Supervisory Switches: Connect for each sprinkler valve station required to be supervised.
D. Ceiling-Mounted Smoke Detectors: Not less than 4 inches (100 mm) from a side wall to the near edge. For exposed solid joist construction, mount detectors on the bottom of joists. On smooth ceilings, install not more than 30 feet (9 m) apart in any direction.
E. Smoke Detectors near Air Registers: Install no closer than 60 inches (1520 mm).

F. Duct Smoke Detectors: Comply with manufacturer's written instructions.
   1. Verify that each unit is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
   2. Install sampling tubes so they extend the full width of the duct.
G. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
H. Audible Alarm-Indicating Devices: Install not less than 80” AFF to centerline of device or 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Combine audible and visible alarms at the same location into a single unit.
I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.
J. Device Location-Indicating Lights: Locate in public space near the device they monitor.
K. FACP: Surface mount with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
L. Annunciator: Install with the top of the panel not more than 72 inches (1830 mm) above the finished floor.

3.03 WIRING INSTALLATION

A. Wiring Method: In non-accessible locations, install wiring in metal raceway according to Division 26 "Raceways and Boxes." Conceal raceway except in unfinished spaces and as indicated. Utilize J-hooks in accessible locations, do not share with other systems.
B. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by the manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
C. Cable Taps: Use numbered terminal strips in junction, pull and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
D. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
E. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signal from other floors or zones.
F. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.04 OWNER PERSONNEL INSTRUCTION

A. Provide the following instructions to designated Owner personnel:
   1. Hands-On Instruction: On-site, using operational system.
   2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
B. Basic Operation: 2-2-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on.
C. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

3.05 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
   1. Be prepared to conduct any of the required tests.
      Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   2. Have authorized technical representative of control unit manufacturer present during demonstration.

3. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
4. Repeat demonstration until successful.

B. Occupancy of the project will not occur prior to Substantial Completion.

C. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
1. Approved operating and maintenance data has been delivered.
2. Spare parts, extra materials, and tools have been delivered.
3. All aspects of operation have been demonstrated to Owner.
4. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
5. Occupancy permit has been granted.
6. Specified pre-closeout instruction is complete.

3.06 MAINTENANCE

A. See *Division 01 70 00* - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide to Owner and include, at no extra cost, a written maintenance contract for a period of one year from date of acceptance of building.

C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
3. Record keeping required by NFPA 72 and authorities having jurisdiction.

D. Provide trouble call-back service upon notification by Owner:
1. Provide on-site response within 2 hours of notification.
2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.

G. Comply with Owner's requirements for access to facility and security.

3.07 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Electrical Identification."

B. Install instructions frame in a location visible from the FACP.

C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.08 GROUNDING

A. Ground cable shields and equipment according to system manufacturer's written instructions to eliminate shock hazard and to minimize, to the greatest extent possible, ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements in Division 26 Section "Grounding."

D. Ground equipment and conductor and cable shields. For audio circuits, minimize, to the greatest extent possible, ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

3.09 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and connections and to supervise pretesting, testing, and adjustment of

the system. Report results in writing.

B. Pretesting: After installation, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the compliance of the system with requirements of Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones, and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

C. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of witnesses to preliminary tests.

D. Final Test Notice: Provide a minimum of 10 days' notice in writing when the system is ready for final acceptance testing.

E. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

F. Provide all tools, software, and supplies required to accomplish inspection and testing.

G. Minimum System Tests: Test the system according to procedures outlined in NFPA 72. Minimum required tests are as follows:
   1. Verify the absence of unwanted voltages between circuit conductors and ground.
   2. Test all conductors for short circuits using an insulation-testing device.
   3. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on record drawings.
   4. Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.
   5. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
   6. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
   7. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level.
   8. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.

H. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets Specifications and complies with applicable standards.

I. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log on the satisfactory completion of tests.

J. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

K. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
   1. Record all system operations and malfunctions.
   2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
   3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
   4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.10 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

DIVISION 31 00 00 – SITE DEVELOPMENT DESIGN CONSIDERATIONS

GENERAL

All exterior development, including paving, landscaping, fencing, lighting and planting shall be included in the contract for construction. There are various issues that need to be addressed in the site design of a school. These considerations include:

(1) The allowance for future building expansion and accommodation of future re- locatable classrooms;
(2) The development of circulation patterns that separate pedestrian from vehicular traffic, the bus drop/parking from the parent drop off and staff parking from student parking;
(3) Main building entrances which are readily identifiable and provide shelter for student early arrival;
(4) Building orientations and configurations which conserve energy and allow for daylighting and ventilation. Providing accessibility to all buildings and play areas as per Building Code and ADA requirements; Sidewalk systems and improvements as prescribed by the Zoning Code (17.20.120) are required.

BUILDING EXPANSION AND PORTABLES CLASSROOMS: The planning for future building expansion and re- locatable classrooms shall consider grading, circulation patterns and utility stub-outs. An area large enough for six re-locatable classrooms shall be identified on the site plan. Additionally, an area for future expansion of six permanent classrooms separate from the re-locatable classrooms shall also be included on the site plan.

BUS DROP OFF, STUDENT DROP OFF AND PARKING TRAFFIC: These three functions should be separated. At all drop-off areas the discharge or pick-up of students at the loading-unloading zones shall be from the right side of the vehicle (opposite the driver) and towards the building. The following percentages are a “rule of thumb” for a typical elementary school (contact: MSCS Department of Transportation for more specific data): 60 % Buses 25 % Cars 15% Walkers and Bikes. MSCS' longest bus has a length of 40’ – 0’ and a capacity of 84 students.
Parking bays for full-service buses shall be a minimum of 15' wide. Backing up of buses shall not be permitted.
A minimum turning radius of 35 feet shall be provided at bus driveways and parking areas. Linear sidewalks shall be provided at each loading/unloading area.
Covered canopies shall be included at all drop-off areas for protection during inclement weather.

COURTYARDS: Interior courtyards should be designed as low maintenance as possible.

PLAYGROUNDS: Shall be provided as per program requirements.

- The playground shall be designed to accommodate children ranging either from two (2) to five (5) or five (5) to twelve (12) years of age on main playground as required, or both.
- The color theme should be chosen by the end user and should include appropriate signage to inform users of property safety requirements.
- All structural components, tubing, decks, ladders, etc. shall be constructed of galvanized steel or aluminum and finished with polyester dry powder coating, plastisol vinyl coating, or zinc plating.
- All bolts, nuts, screws, washers, and other hardware used for assembly of equipment must be corrosion resistant stainless steel.
- All play equipment shall have a maximum fall height not greater than eight feet (8’).
- All slides, roofs, and other plastic components shall be rotationally molded of a linear, low density, UV and color stabilized, polyethylene.
- Contractors shall meet manufacturers’ specifications and industry standards for installation.
- Systems shall meet current ADA accessibility requirements.
- Systems shall meet National Playground standards as referenced in the American Society for Testing and Materials (ASTM) document F1487-95; Standard Consumer Safety Performance Specification for Playground Equipment for Public Safety. Evidence of compliance shall be submitted and stamped on equipment as required.

- System shall meet National playground standards as referenced in the U.S. Consumer Product Safety Commission's publication No. 325 Handbook for Public Playground Safety. Evidence of compliance shall be submitted and stamped on equipment as required.
- The contractor shall supply a complete description of the length and type of parts the warranty covers on all pieces of equipment.
- Initial inspection of equipment shall be made within the week of installation.
- Twelve inches (12") (after compaction) of handicap accessible engineered safety surface, above ground with no drains, shall be provided and installed by the contractor. Mulch safety surface shall be certified playground mulch.
- A border system of durable material must enclose the protected play area.
- The safety surface and border system shall be constructed on top of existing grade.
- Replacement parts books and installation instructions shall be supplied for all
- proposed playground components.
- All vertical and horizontal climbers must have deck enclosures.
- The playground system will be a multi-colored system. Specific color combinations
- to be determined.

SCOPE OF WORK

The scope of work covers, and is not limited to the design, procurement, site preparation, and installation of play equipment, including safety surfacing and site amenities, demolition of existing structures, excavation, concrete work for footings, equipment assembly, border installation, drainage, fencing and final safety inspections to meet ASTM and ADA standards.

Preconstruction/Design Phase: Development of site plans, layout, and selection of equipment for specific age groups (e.g., 2-5 or 5-12 years).
Site Preparation & Demolition: Removal of existing structures, clearing, grubbing, topsoil stripping, and grading.

Civil & Infrastructure Work: Installation of drainage systems, underground utilities, stormwater management, fencing, concrete walkways and installing perimeter borders.

Equipment Installation: Assembly and installation of play structures, inclusive equipment, fitness equipment, or spray parks, often requiring certified installers.

Safety Surfacing: Installation of poured-in-place (PIP) rubber engineered wood fiber, rubber mulch or tiles in compliance with safety regulations. Requires 12 inches of loose-fill material or compliant rubber surfacing to cushion falls.

Site Amenities: Installation of benches, picnic shelters, trash receptacles, and signage as applicable.

Inspection & Certification: Final, post-installation inspection by a certified representative to ensure safety compliance and warranty issuance.

Accessibility: Must meet ADA requirements for access to and within the play area.

Compliance & Cleanup: Ensuring all work meets ADA, ASTM F1487-21, and CPSC safety standards, followed by site cleanup and restoration.

EXTERIOR MECHANICAL AREAS: Shall be enclosed with security fencing as noted in Section 02830. Provide reinforced concrete slab within the fenced area with proper sized pads/curbs for equipment mounting. Slope slab away from building. Zoning may require this equipment to be visually screened.
TREES: Deciduous trees are recommended for summer sun shading, winter sun penetration, and use of conifer trees for summer sun shading and winter wind breaks. Landscaping shall be as required by local planning ordinances. Tree species shall be considered in regards to location related so as not to interfere with security camera locations and potential maintenance issues.

DIVISION 31 10 00 - SITE CLEARING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Protecting existing vegetation to remain.
   2. Removing existing vegetation.
   3. Clearing and grubbing.
   4. Stripping and stockpiling topsoil.
   5. Stripping and stockpiling rock.
   6. Removing above- and below-grade site improvements.
   7. Disconnecting, capping or sealing, and removing site utilities.
   8. Temporary erosion and sedimentation control.

1.02 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches (50.8 mm) in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.03 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.04 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1.05 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion- and sedimentation- control and plant-protection measures are in place and in full compliance with the approved project Stormwater Pollution Prevention Plan (SWPPP).

D. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in *Division 31 20 00* "Earth Moving."
   1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.
B. Protect existing site improvements to remain from damage during construction.
    1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to the approved project SWPPP, erosion- and sedimentation- control Drawings, and requirements of authorities having jurisdiction.
B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
C. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.03 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
    1. Arrange with utility companies to shut off indicated utilities.
B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
    1. Notify Engineer not less than 7 days in advance of proposed utility interruptions.
    2. Do not proceed with utility interruptions without Engineer's written permission.
D. Excavate for and remove underground utilities indicated to be removed.

3.04 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
    1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
    2. Grind down stumps and remove roots larger than 2 inches (50.8 mm) in diameter, obstructions, and debris to a depth of 18 inches (457.2 mm) below exposed subgrade.
    3. Use only hand methods or air spade for grubbing within protection zones.
    4. Chip removed tree branches and dispose of off-site.
B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
    1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (203.2 mm) and compact each layer to a density equal to adjacent original ground.

3.05 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.
B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
    1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches (50.8 mm) in diameter; trash, debris, weeds, roots, and other waste materials.
C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
    1. Limit height of topsoil stockpiles to 4 feet (121.92 cm).
    2. Do not stockpile topsoil within protection zones.
    3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity to be reused.

3.06 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
    1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

3.07 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

DIVISION 31 20 00 - EARTH MOVING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Excavating and filling for rough grading the Site.
   2. Preparing subgrades for slabs-on-grade, walks, pavements, and turf and grasses.
   3. Excavating and backfilling for buildings and structures.
   4. Drainage course for concrete slabs-on-grade.
   5. Subbase course for concrete walks, and pavements.
   6. Subbase course and base course for asphalt paving.
   7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:
   1. *Division 3110 00* "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
   2. *Division 31 50 00* "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
   3. *Division 32 92 13* "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
   4. *Division 32 93 00* "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.02 DEFINITIONS

A. See Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Trench Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, will be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site, and, borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D698 or ASTM D1557 as applicable.

1.04 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

1.05 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in the approved project Stormwater Pollution Prevention Plan (SWPPP), the drawings, *Division 01 50 00* "Temporary Facilities and Controls", and *Division 31 10 00* "Site Clearing" are in place.

D. Do not commence earth-moving operations until plant-protection measures are in place.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Suitable Backfill Soils: Soil Classification Silt, lean clay, silty sand, or clayey sand (Groups ML, CL, SM, or SC according to ((ASTM D2487))); free of rock or gravel larger than 2 inches (50.8 mm) in any dimension, organic matter, debris, waste, frozen materials, vegetation, and other deleterious matter.
   1. Liquid Limit: 45 max.
   2. Plasticity Index: 20 max.
   3. On site soils generally meet these requirements provided they are moisture-conditioned during construction as described.

C. Trench Backfill: #67 (1” minus) crushed limestone or CR 610 stone.

2.02 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (152.4 mm) wide and 4 mils (0.1016 mm) thick, continuously inscribed with a description of the utility; colored as follows:
   1. Red: Electric.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

PART 3 EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

D. Existing structures, pavements, and sidewalks at the site should be demolished and removed prior to continued construction. In general, cut areas and areas to receive new fill should be stripped of vegetation, topsoil, and other deleterious materials. Topsoil should be replaced in landscape areas or disposed of off-site. Vegetation and tree roots, where encountered should be over-excavated. Contractors should account for the removal of vegetation, tree roots, and existing utilities in their estimates.

3.02 DEWATERING

A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
    1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.03 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
    1. Excavation shall consist of the removal of all suitable or unsuitable material in cut sections to the lines, grades, and cross-sections shown on the Plans. All slopes, ditches and berms shall be neatly trimmed to the lines given. Excavation beyond given lines or to correct slides, regardless of the location, will be at the Contractor's expense, and the suitability of the material from slides for embankment construction will be determined by the Owner.
    2. Surplus excavated material, if determined to be suitable by the Owner, may be used to widen embankments or to flatten slopes or may be deposited in other places and for such other purposes as the Owner may approve. Materials unsuitable for construction of embankment or use as backfill shall be removed to off-site waste disposal areas. The Contractor shall secure waste disposal areas and dispose of surplus and unsuitable materials in such areas. It is the Contractor's responsibility to obtain written permission
        a. from the owners of all property(s) to be used for waste disposal areas prior to removal of material to disposal sites. The Contractor shall dispose of all materials on the sites to the satisfaction of the property owner(s).
    3. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.04 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25.4 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
    1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
    2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25.4 mm). Do not disturb bottom of excavations intended as bearing surfaces.

3.05 EXCAVATION FOR SUBGRADE AND ROADBED

A. This work shall consist of the final preparation of the roadbed to receive the immediate construction of a base or pavement, curb and gutter, driveways, or sidewalks thereon.
B. After performing site preparation and excavations in cut areas, the exposed subgrade should be proof-rolled using a tandem-axle dump truck loaded approximately 20,000 pounds per axle (or equivalent proof-rolling equipment) under the review of the project geotechnical engineer or their representative. This requirement may be waived if the geotechnical engineer determines that proof-rolling would disturb an otherwise acceptable subgrade.
C. Soft areas or pumping subgrade that develop during proof-rolling should be over-excavated and backfill with soil compacted to the densities specified subsequently in this report prior to placement of fill or continued construction. The geotechnical engineer or their representative should be onsite to observe proof-roll operations and make recommendations for improvement.

D. Subgrade preparation in cut areas shall consist of the compaction of the top six (6) inches below subgrade elevation in paved areas only to a density of 98 percent as determined by a standard Proctor test (((ASTM D698))).
E. The Contractor shall be held responsible for the proper maintenance of subgrade acceptable to the Engineer. The Contractor shall also take all precautions necessary to protect the acceptable subgrade from damage, and hauling over the finished subgrade shall be limited to that which is essential for construction purposes.

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.07 EXCAVATION FOR UTILITY TRENCHES AND STRUCTURES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
B. Excavate trenches to uniform widths to provide clearance on each side of pipe or conduit as shown in the Drawings. Excavate trench walls vertically from trench bottom to 12 inches (304.8 mm) higher than top of pipe or conduit unless otherwise indicated.
C. Trenches may be excavated by machinery to a depth that will not disturb the finished subgrade. The remaining material shall be hand excavated so that the pipe may be laid on a firm, undisturbed subgrade.
D. No more than 300 feet (9144 cm) of trench shall be opened at any time in advance of the completed storm drain, nor shall more than 100 feet (3048 cm) be left unfilled except by written permission from the Engineer.
E. The sides of the trench shall be as nearly vertical as possible. The bottom of the trench shall be carefully graded, formed, and aligned according to the Plans and to the satisfaction of the Engineer before storm drains are laid thereon.
F. Trench Bottoms:
    1. Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
        a. For pipes and conduit less than 6 inches (152.4 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
        b. For pipes and conduit 6 inches (152.4 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
        c. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
        d. Excavate trenches 6 inches (152.4 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
    2. Excavate trenches 6 inches (152.4 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
        a. Excavate trenches 6 inches (152.4 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
G. Excavation for Drainage Structures:
    1. The Contractor shall be responsible for prosecuting the Work in accordance with the lines and elevations shown on the Plans or as directed by the Engineer. The Contractor shall excavate as required for all structures with foundations carried to firm, undisturbed earth at the elevation of the underside of the structure.
    2. The outside dimensions of all manholes, inlets, and other drainage structure excavations shall be at least 12 inches (304.8 mm) greater than the outside of the masonry or concrete work to permit backfilling around structure.
    3. Where structures are to be built in City of Memphis street right-of-way or paved areas, the excavation shall not exceed 2 feet (60.96 cm) from the outside of the masonry or concrete work. In the event that the excavation exceeds this limit, the Contractor will be required, at his expense, to backfill the entire space around the structure with suitable material compacted as specified.

4. For drainage facilities to be constructed in fill areas, the fill shall first be placed and compacted in accordance with these Specifications. The excavation for the drainage facilities shall then commence following the placement of fill.

H. Trenches in Tree- and Plant-Protection Zones:
   1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
   2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
   3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.08 SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.
B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.09 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17236.90 kPa), may be used when approved by Engineer.
   1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, subdrainage, damp proofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for Record Documents.
   3. Testing and inspecting underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring, bracing, and sheeting.
   7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
B. Place backfill on subgrades free of mud, frost, snow, or ice.
C. Fill and backfill should be placed in level lifts, up to 8 inches (203.2 mm) in loose thickness.
   1. For soils that exhibit a well-defined moisture density relationship, each lift should be moisture-conditioned to within 2% of the optimum moisture content as measured by ASTM D698. Moisture-conditioning can include: aeration and drying of wetter soils; wetting drier soils; and/or mixing wetter and drier soils into a uniform blend.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.
B. Place and compact bedding course on trench bottoms and where shown in the drawings. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
C. Backfill voids with satisfactory soil while removing shoring and bracing.
D. Trench Backfill:
   1. Use #67 crushed limestone or CR 610 stone.
      a. Carefully compact initial backfills under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

b. In paved areas, extend Trench Backfill to bottom of the pavement section.
c. In unpaved areas, extend Trench Backfill to the limits shown in the drawings. Use suitable Backfill above Trench Backfill to finished grade.

E. Warning Tape: Install warning tape directly above utilities, 12 inches (304.8 mm) below finished grade, except 6 inches (152.4 mm) below subgrade under pavements and slabs.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontals so fill material will bond with existing material.
B. Place and compact fill material in layers to required elevations as follows:
1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Fill and backfill should be placed in level lifts, up to 8 inches (203.2 mm) in loose thickness.
B. For soils that exhibit a well-defined moisture density relationship, each lift should be moisture-conditioned to within the acceptable moisture content range.
1. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698:
a. Structural Areas: 95%
b. Non-Structural Areas:92%
c. Pavement Subgrades: 98%
C. For granular soils that do not exhibit a well-defined moisture-density relationship, minimum relative density requirements (ASTM D4253 maximum, ASTM D4254 minimum) are as follows:
1. Structural Areas: 70%
2. Non-Structural Areas: 70%
3. Pavement Base Course: 75%
D. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

3.16 DRAINAGE BACKFILL

A. Subsurface Drain: Place subsurface drain geotextile around perimeter of subdrainage trench. Place a 6-nch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (304.8 mm) of filter material, placed in compacted layers 6 inches (152.4 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
1. Compact each filter material layer with a minimum of two passes of a plate-type vibratory compactor.
B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (304.8 mm) of final subgrade, in compacted layers 6 inches (152.4 mm) thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
1. Compact each filter material layer with a minimum of two passes of a plate-type vibratory compactor.
2. Place and compact impervious fill over drainage backfill in 6-inch thick compacted layers to final subgrade.

3.17 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.
B. On prepared subgrade, place and compact drainage course as follows:
1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written

instructions, overlapping sides and ends.
2. Place drainage course 6 inches (152.4 mm) or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches (152.4 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches (76.2 mm) thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.18 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
   1. Turf or Unpaved Areas: Plus or minus 1 inch (25.4 mm).
   2. Walks: Plus or minus 1 inch (25.4 mm).
   3. Pavements: Plus or minus 1/2 inch (12.7 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (12.7 mm) when tested with a 10- foot straightedge.

3.19 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
   2. Determine that fill material classification and maximum lift thickness comply with requirements.
   3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

DIVISION 31 21 00 - CEMENT SOIL STABILIZATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes work consisting of constructing a base composed of in-place soil material in the roadway and Portland cement uniformly mixed, moistened, compacted, finished, and cured in accordance with these Specifications and in conformity with the lines, grades, thickness and typical cross-section shown on the Plans

B. Related Requirements:

1. *Division 31 10 00* "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. *Division 31 20 00* "Earth Moving" for excavation, backfill, and grading.

1.02 DEFINITIONS

A. EQUIPMENT: All equipment necessary for the satisfactory performance of this construction shall be on the Project and approved before work will be permitted to begin.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each soil material proposed as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D698 or ASTM D1557 as applicable.

1.04 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

1.05 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Soil for soil-cement base shall be of such general character as to be classified as Group A-1or A-2, AASHTO M 145. The material shall be of such size that all will pass the standard two (2) inch sieve. Samples shall be tested by the Geotechnical Engineer before work is started for determination of cement application rates and optimum moisture content.

2.02 PORTLAND CEMENT

A. Portland Cement shall comply with the latest specifications for Portland cement, AASHTO M 85 or AASHTO M 240 for the type specified.

2.03 WATER

A. Water shall be free of injurious quantities of oil, salt, acid, alkali, sugar, vegetable matter, or other substances detrimental to the hardening of the treated base.

2.04 BITUMINOUS MATERIAL

A. Bituminous material for curing shall be Emulsified Asphalt Type SS-1, RS-2, or Cut- Back Asphalt, Grade RC-250.

PART 3 - EXECUTION

3.01 LIMITATIONS

A. No soil-cement shall be processed that will not be covered with the succeeding stage of base or pavement during the same construction season. No cement shall be applied when the soil is frozen or contains frost. Before beginning construction operations for the day, the ambient temperature shall be at least 40-deg F in the shade and rising. All operations shall be continuous, and all operations but final surface finish shall be completed within four (4) hours from the time cement is applied. No uncompacted soil-

B. cement mixture shall be left undisturbed for more than thirty (30) minutes.

3.02 PREPARATION

A. Before other operations are begun, the roadbed, including depth of soil for the soil- cement base, shall be graded and shaped in accordance with Section 312000 of these Specifications. After grading operations are complete and approved, any work and material required to regrade the roadbed to finished grade shall be at the Contractor's expense. The area to receive treatment shall be thoroughly scarified and pulverized for sufficient depth and width to give, after treatment and compaction, the cross-sections shown on the Plans.

3.03 MOISTURE CONTENT

1. The optimum moisture content should be established by soil tests or as designated by the Engineer. The maximum percentage of moisture in the soil at the time cement is added shall not exceed the specified moisture content of the soil-cement mixture by more than three (3) percentage points. When water application and mixing have been completed, the percentage of moisture in the mixture, based on oven-dried weights, shall not be more than one (1) percentage point below or more than three (3) percentage points above the specified optimum moisture content and shall be such that the mixture will not become unstable during compacting and finishing. During finishing operations, the moisture content of the surface material shall be maintained at not less than the specified optimum moisture content.

3.04 APPLICATION OF CEMENT.

A. Approved Portland cement shall be applied uniformly on the in-place soil at the rate established by the Engineer, based on tests of the soil performed before work is begun. The Engineer reserves the right to increase the rate of cement where in his judgment additional cement is desired. When bulk cement is used, adequate equipment for handling, weighing, and spreading the cement shall be provided.

3.05 MIXING.

A. After the cement has been applied it shall be mixed with the soil so that the specified thickness of base shall be a homogeneous soil-cement mixture. Water shall be added and mixing shall continue until the mixture is sufficiently blended to prevent the formation of cement balls when additional water is added.

3.06 APPLICATION OF WATER AND MOIST MISTING.

A. Immediately after the soil and cement have been mixed, water shall be applied uniformly and incorporated into the mixture. Excessive concentration of water on or near the surface shall be avoided. A water supply and pressure distributing equipment that will ensure the application within three (3) hours of all water required. After all water has been applied, mixing shall continue until a uniform and intimate mixture of soil-cement and water has been obtained.

3.07 COMPACTION.

A. Prior to the beginning of compaction, the mixture shall be in a loose condition for a depth to produce the specified finished thickness. As a continuation of mixing operations, the loose mixture then shall be uniformly compacted to ninety-five (95) percent of maximum density as determined by AASHTO T 134 with two (2) hours. Initial compaction shall be obtained by use of a sheep's-foot roller of adequate weight to thoroughly compact the base for the full thickness. During compaction operations, shaping may be required to obtain uniform compaction and required grade and cross.

3.08 FINISHING.

A. After the mixture has been compacted, the surface of the soil-cement shall be shaped, if necessary, to the required lines, grades, and cross-sections shown on the Plans. During shaping operations, the surface shall be lightly scarified as necessary to loosen any imprints left by the compacting or shaping equipment. The resulting surface shall then be compacted to the specified density with steel wheel or pneumatic tire rollers or both. Rolling shall be supplemented by broom dragging if required.

B. Surface compaction and finishing shall be done in such a manner as to produce, within two (2) hours, a smooth, dense surface free of surface compaction planes, cracks, ridges, or loose material. Any approved surface finishing method may be used provided the above final results are produced.

3.09 CURING.

A. After the soil-cement has been finished as specified herein, it shall be protected against drying for seven (7) days by the application of bituminous material as specified or allowed by the Engineer. The bituminous material shall be applied as soon as possible, but no later than two (2) hours after finishing is completed. The finished soil- cement shall be kept continuously moist until the bituminous material is placed.

B. The bituminous material shall be uniformly applied at the rate of approximately 0.2 gallons per square yard with approved heating and distributing equipment. The exact rate and temperature of application to give complete coverage without excessive run- off may be specified by the Engineer.

C. At the time the bituminous material is applied the soil-cement shall be dense, free of all loose and extraneous material, and shall contain sufficient moisture to prevent penetration of the bituminous material. Water shall be applied in sufficient quantity to fill any surface voids immediately before the bituminous material is applied.

D. The curing material shall be maintained by the Contractor during the seven (7) day protection period so that all of the soil-cement will be covered effectively.

E. Should it be necessary for construction equipment or any other traffic to use the bituminous covered surface before it has dried sufficiently to prevent pickup, sufficient granular cover shall be applied before such use as directed by the Engineer. Finished portions of the soil-cement that are traveled on by equipment or other traffic for any reason shall be protected in such a manner as to prevent marring or damaging the completed work.

F. When the ambient temperature may be expected to reach the freezing point, sufficient protection from freezing shall be given the soil-cement for seven (7) days after finishing and until it has hardened.

3.10 CONSTRUCTION JOINTS.

A. At the end of each day's construction a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face free of loose or shattered material.

Soil-cement for large, wide areas shall be built in a series of parallel lanes of convenient lengths and width meeting the approval of the Engineer. Straight longitudinal joints shall be formed at the edge of teach day's construction by cutting back into the completed work to form a true vertical face free of loose or shattered material.

3.11 MANHOLE ADJUSTMENTS.

A. Drainage and sanitary sewer manholes shall be adjusted and set at final grade by the Contractor as necessary for compliance with the Plans. Manholes, valve boxes, and other utility structures shall be adjusted as necessary by the owner of such facilities. The Contractor shall be responsible for notifying other owners of any required adjustments and for the accomplishment of that work by the owner of such facilities according to the project schedule.

3.12 TRAFFIC AND MAINTENANCE.

A. Completed portions of the soil-cement may be opened immediately to construction equipment and local traffic, and to all traffic after the seven (7) day curing period, provided the soil-cement has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic and provided curing specified above is not impaired.

B. The Contractor shall be required to maintain the soil-cement in good condition and in a manner satisfactory to the Engineer from the time work first starts until all work has been completed and accepted. Maintenance shall include immediate repairs of any defects that may occur. This work shall be done by the Contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact. This work shall include immediate repairs to any defects that may occur in a manner that will ensure restoration of a smooth, uniform surface and durability of the area repaired. Any faulty work shall be replaced to the full depth of treatment, rather than adding a thin layer of material to the completed work.

DIVISION 31 31 00 - TERMITE CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Chemical soil treatment.
B. Site-applied termiticide for wood, steel, and concrete.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Vapor barrier placement under concrete slab-on-grade.

1.03 REFERENCE STANDARDS

A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 2019.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
C. Test Reports: Indicate regulatory agency approval reports when required.
D. Manufacturer's Certificate: Certify that toxicants meet or exceed specified requirements.
E. Manufacturer's Instructions: Indicate caution requirement.
F. Record and document moisture content of soil before application, date and rate of application, areas of application, diary of toxicity meter readings and corresponding soil coverage, and termiticide brand name and manufacturer.
G. Maintenance Data: Indicate re-treatment schedule .
H. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing this type of work and:
   1. Having minimum of three (3) years documented experience.
   2. Approved by manufacturer of treatment materials.
   3. Licensed in the State in which the Project is located.

1.06 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.
B. Provide five year installer's warranty against damage to building caused by termites.
   1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.
   2. Inspect annually and report in writing to Owner. Provide inspection service for five (5) years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 CHEMICAL SOIL TREATMENT

A. Toxicant Chemical: EPA Title 7, United States Code, 136 through 136y approved; synthetically color dyed to permit visual identification of treated soil.
B. Diluent: Recommended by toxicant manufacturer.
C. Manufacturers:
   1. Bayer Environmental Science Corp: www.backedbybayer.com/pest-management/#sle.
   2. FMC Professional Solutions: www.fmcprosolutions.com/#sle.
   3. Nisus Corporation; Bora-Care: www.nisuscorp.com/#sle.
   4. Syngenta Professional Products: www.syngentaprofessionalproducts.com/#sle.
   5. Approved Equal.
   6. Substitutions: See *Division 01 60 00* - Product Requirements.
D. Mixes: Mix toxicant to manufacturer's instructions.

2.02 SITE-APPLIED TERMITICIDE

A. Site Applied Termiticide for Wood, Steel and Concrete: Borate mineral salt based, spray applied termiticide formulated for use on wood, steel, concrete and other building materials.
   1. Active Ingredient: 40% minimum disodium octaborate tetrahydrate (DOT).
   2. Carrier and Penetrant: Proprietary glycol solution.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive

treatment.

B. Verify final grading is complete.

3.02 APPLICATION - SITE APPLIED TERMITICIDE

A. Comply with requirements of U.S. EPA and applicable state and local codes.

B. Spray apply toxicant in accordance with manufacturer's instructions.

C. Apply toxicant at following locations:

1. Under Slabs-on-Grade.
2. At Both Sides of Foundation Surface.
3. Soil Within 10 feet of Building Perimeter For a Depth of two (2) feet.

D. Under slabs, apply toxicant immediately prior to installation of vapor barrier.

E. At foundation walls, apply toxicant immediately prior to finish grading work outside the foundations.

F. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.

G. Re-treat disturbed treated soil with same toxicant as original treatment.

H. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.03 PROTECTION

A. Do not permit soil grading over treated work.

RE-TREATMENT AND REPAIR: If subterranean termite activity is discovered during the warranty period, the Contractor will re-treat soil and repair or replace damage caused by termite infestation, without cost to the Owner.
The Contractor shall pay the entire cost of re-treatment if required to comply with these specifications including the cost of providing access to the soil, repair of resulting damage to concrete, and project delays.

SOIL TREATMENT SOLUTION: Use an emulsifiable concentrate termiticide for dilution with water, specially formulated to prevent infestation by termites. Provide a solution recommended by Applicator acceptable to the Architect and approved for intended application by the manufacturer and registered and approved by EPA and the Tennessee Department of Agriculture. Use only soil treatment solutions that are not injurious to planting.

DIVISION 32 10 00 – EXTERIOR IMPROVEMENTS

GENERAL

FIRE DEPARTMENT ACCESS ROADS: Shall be coordinated with fire department authorities and MSCS for acceptable materials and locations.

CONCRETE WALKS: Shall be a minimum of 3500 psi concrete 4" thick and 5' wide with a broom finish. Preferred reinforcement is fiber reinforcement and admixture. A secondary preference is reinforcement with welded wire mesh and install construction joints at a maximum of 5' on center and expansion joints at a maximum of 30' on center. Use wider walkways at entrances and bus and parent drop off areas. Where sidewalks are adjacent to entrances or may be used for maintenance or delivery access they shall be reinforced and thickened to meet concrete paving requirements noted below. Walks along roads shall comply with Shelby County standards.

Repair of any concrete curbing and sidewalk modifications for ADA compliance.

Repairing/cleaning of all storm drainage grates, catch basin boxes, and curb inlets located in parking areas, clean outs, utility valves, utility covers such as but not limited to SA manhole covers if need of required repair/ replacement of vehicular concrete paving and on-site traffic and school signage.

Contractor is responsible for all storm drainage protection. Storm drainage protecting must be approved before installation.

Pour 2’ x 2’x 6“thick concrete apron around existing clean-outs, utility valves, etc. to ensure proper tie in, in all cases for complete and functioning system.

Striping of all parking areas, speed bumps, crosswalks, handicap areas, fire lanes, specified staff/admin parking areas, dumpster pad area, etc. Paint all concrete light pole bases, parking bumpers/wheel stops,

pipe bollards, and all other hazards located in parking areas that extend more than 1in above any finished product with high traffic yellow paint.

Spoils must NOT be stored on site and should be removed daily.

CONCRETE CURB: Extruded concrete curb is acceptable where properly installed and back filled. Use of extruded curb on the surface of roadway is unacceptable. Rolled concrete curb locations shall be reviewed and discussed with Director of Grounds for implementation into the project.

CONCRETE WALKS: Flare out walk surfaces at intersections.

CONCRETE PAVING: Shall be provided 12' in front of dumpster pad locations, adjacent to entrances which may be used for maintenance or delivery access and service docks. Thickness and reinforcement shall be determined by Designer based on weight and type of dumpster removal vehicle.

CONCRETE CURB & GUTTER: Shall be provided at all concrete and asphalt paved areas as required.

GRAVEL SERVICE ROADS: Use of gravel surfaced roads is prohibited unless directed otherwise.
PARKING LOT STRIPING: Parking lot striping shall be painted in white. Blue lines may supplement white parking lot striping in parking spaces designated for use by people with disabilities.

DIVISION 32 12 00 – ASPHALT PAVING

PART 1 - GENERAL

ASPHALT PAVING: Shall be a minimum of 1½" surfacing on 2" of binder on 10" min. compacted base course at heavy-duty driveways and bus parking areas. At car parking areas and driveways, paving shall be a minimum of 2" surfacing on 8" compacted base course.
Design and Engineering shall utilize the "Design/ Planning Principles & Construction Guidelines for Shelby County Schools", latest edition.
Design fees are to include required due diligence services including but not limited to those items as listed in Section III "Due Diligence" of the "Design/Planning Principles & Construction Guidelines for Shelby County Schools", latest edition.
If required, design services shall include but not be limited to all design, sustainability, ADA compliance, estimating, phasing plans, demolition, civil, landscaping, life safety, and site utility.
The Basis of Design will be to remove/demo and replace all asphalt paving and speed bumps with new light duty and heavy-duty paving. See attached picture for heavy duty pavement in red and light duty pavement in blue.
Stabilize sub-base for new paving in all cases. Contractor will be responsible for all testing of subgrade, asphalt, etc. for a complete and functioning system, which includes corrective & preventive erosion control measures as well as grading modifications, as needed.

1.01 SUMMARY

A. Section Includes:
   1. Hot-mix asphalt paving.
   2. Hot-mix asphalt patching.
B. Related Requirements:
   1. *Division 31 20 00* "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.

1.02 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
      a. Review proposed sources of paving materials, including capabilities and location of the plant that will manufacture hot-mix asphalt.
   2. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.03 ACTION SUBMITTALS

A. Hot-Mix Asphalt Designs:

1. For each hot-mix asphalt design proposed for the Work.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For paving-mix manufacturer.

B. Material Certificates: Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.
   1. Aggregates.
   2. Asphalt binder.
   3. Asphalt cement.
   4. Emulsified asphalt prime coat.
   5. Tack coat.

C. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or TDOT.

B. Testing Agency Qualifications: Qualified in accordance with ASTM D3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of City of Memphis or TDOT Standard Construction Specifications for asphalt paving work.

1.06 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
   1. Prime Coat: Minimum surface temperature of 60 degrees Fahrenheit (15.56 degrees Celsius).
   2. Tack Coat: Minimum surface temperature of 60 degrees Fahrenheit (15.56 degrees Celsius).
   3. Asphalt Binder Course: Minimum surface temperature of 40 degrees Fahrenheit (4.44 degrees Celsius) and rising at time of placement.
   4. Asphalt Surface Course: Minimum surface temperature of 60 degrees Fahrenheit (15.56 degrees Celsius) at time of placement.

PART 2 - PRODUCTS

1.01 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone,or crushed gravel.
   1. For Mix No. 1, material retained on the No. 4 sieve shall have a maximum of 20 percent elongated pieces (length greater than five times the average thicknesses).
   2. For Mix No. 2, the aggregate shall contain no more than 5 percent soft or nondurable particles.

C. Fine Aggregate: ASTM D1073, sharp-edged natural sand consisting of hard, clean, tough grains which will have a maximum loss of 12 percent when subjected to the sodium sulfate soundness test.

D. The composition of the mixes shall be as follows:

Total Percent Passing by Weight		
Sieve Size	Mix No. 1	Mix No. 2
2”	100	100
1-1/2”	100	100
3/4”	100	100
3/8”	76 - 96	65 - 95
No. 4	51 - 76	45 - 70
No. 8	36 - 60	25 - 50
No. 30	16 - 40	12 - 30
No. 100	3 - 12	2 - 12
No. 200	2 - 8	2 - 6

E. The proportions of the total mixture, in percent by weight, shall be as follows:

Courses	Combined Mineral Aggregate	Asphalt Cement
Mix No. 1, Surface	92.0 – 96.0	4.0 – 8.0
Mix No. 2, Binder	93.0 – 97.5	2.5 – 7.0

F. It is the intent of this Section of the Specifications that the above-described mixes shall conform to the following mixtures specified in the Tennessee Department of Transportation Standard Specifications for Road and Bridge construction.
G. Mix No. 1 – Section 411, Asphaltic Concrete Surface (Hot Mix), Aggregate Grading E.
H. Mix No. 2 – Section 307, Bituminous Plant Mix Base (Hot Mix), Aggregate Grading C.

1.06 ASPHALT MATERIALS

A. Asphalt Binder: ASTM D6373 binder designation PG 64-22.
B. Emulsified Asphalt Prime Coat: ASTM D977 emulsified asphalt of suitable grade and consistency for application.
C. Tack Coat: ASTM D977 emulsified asphalt of suitable grade and consistency for application.
D. Water: Potable.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.
B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.
B. The designated surface upon which asphalt concrete courses are to be placed shall meet the applicable requirements of these specifications and be thoroughly cleaned of all dirt and other foreign or loose matter prior to the application of the Tack Coat or Prime Coat.
C. Once the subgrade is prepared, it should be promptly paved to protect it from the weather, as the naturally occurring soils in the area are susceptible to changes in the moisture content.

3.03 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (304.8 mm) into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 gal./sq. yd.
    1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
    2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
C. Placing Single-Course Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
D. Placing Two-Course Patch Material: Partially fill excavated pavements with hot-mix asphalt base course mix and, while still hot, compact. Cover asphalt base course with compacted layer of hot-mix asphalt surface course, finished flush with adjacent surfaces.

3.04 SURFACE PREPARATION

A. Ensure that prepared subgrade is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.
B. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound- aggregate base course at a rate of 0.25 gal./sq. yd. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
    1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
    2. Protect primed substrate from damage until ready to receive paving.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 gal./sq. yd.
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.05 HOT-MIX ASPHALT PLACEMENT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   1. Place hot-mix asphalt base course and binder course in number of lifts and thicknesses indicated.
   2. Place hot-mix asphalt surface course in single lift.
   3. Spread mix at a minimum temperature of 250 degrees Fahrenheit (121.11 degrees Celsius).
   4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
   5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (304.8 cm) wide unless infill edge strips of a lesser width are required.
   1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches (38 mm) from strip to strip to ensure proper compaction of mix along longitudinal joints.
   2. Complete a section of soil-cement base course and binder course before placing asphalt surface course.

C. Thickness shall be controlled during the spreading operations by frequent measurements taken of freshly spread mixture to establish a relationship between the uncompacted and compacted material. This thickness shall remain in conformity with that specified on the Plans. The deviation of the surfaces from the testing edge of the straightedge shall not exceed [1/4] inch ([6.35] mm) for Mix No. 1 or [3/8] inch ([9.52] mm) for Mix No. 2.

D. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.06 MANHOLE ADJUSTMENTS

A. Drainage and sanitary sewer manholes shall be adjusted and set at final grade by the Contractor as necessary for compliance with the Plans. Manholes, valve boxes, and other utility structures within the project shall be adjusted as necessary. The Contractor shall be responsible for notifying other owners of any required adjustments and for the accomplishment of that work according to the project schedule.

3.07 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
   1. Clean contact surfaces and apply tack coat to joints.
   2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (152.4 mm).
   3. Offset transverse joints, in successive courses, a minimum of 24 inches (609.6 mm).
   4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method in accordance with AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
   5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
   6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.08 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

B. Complete compaction before mix temperature cools to 185 degrees Fahrenheit (85 degrees

Celsius).

C. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
D. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
    1. Average Density, Marshall Test Method: 96 percent of reference laboratory density in accordance with ASTM D6927, but not less than 94 percent or greater than 100 percent.
    2. Average Density, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041/D2041M, but not less than 90 percent or greater than 96 percent.
E. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
F. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
G. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
H. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
I. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.09 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:
    1. Binder Course: Plus or minus 1/2 inch (12.7 mm).
    2. Surface Course: Plus 1/4 inch (6.35 mm), no minus.
B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
    1. Binder Course: 1/4 inch (6.35 mm).
    2. Surface Course: 1/8 inch (3.18 mm).
C. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6.35 mm).

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined in accordance with ASTM D3549/D3549M.
C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement in accordance with ASTM D979/D979M.
    1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared in accordance with ASTM D2041/D2041M, and compacted in accordance with job-mix specifications.
    2. In-place density of compacted pavement will be determined by testing core samples in accordance with ASTM D1188 or ASTM D2726/D2726M.
        a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
        b. Field density of in-place compacted pavement may also be determined by nuclear method in accordance with ASTM D2950/D2950M and coordinated with ASTM D1188 or ASTM D2726/D2726M.
E. Replace and compact hot-mix asphalt where core tests were taken.
F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.11 WASTE HANDLING

A. General: Handle asphalt-paving waste in accordance with local laws and regulations.

DIVISION 32 13 00 – CONCRETE PAVING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes concrete paving including the following:
   1. Driveways.
   2. Roadways.
   3. Parking lots.
   4. Curbs and gutters.
   5. Walks.

B. Related Requirements:
   1. *Division 03 10 00* "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
   2. *Division 03 30 00* "Cast-in-Place Concrete" for general building applications of concrete.
   3. *Division 32 13 10* "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
   4. *Division 32 17 10* "Tactile Warning Surfacing" for detectable warning.

1.02 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product
   1. Portland cement.
   2. Blended hydraulic cement.
   3. Performance-based hydraulic cement.
   4. Fly ash.
   5. Natural or other pozzolans.
   6. Aggregates.
   7. Admixtures:
      a. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.
   8. Curing materials.
   9. Joint fillers.
   10. Repair materials.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

C. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:
   1. Exposed Aggregate: 10-lb Sample of each mix.

D. Design Mixtures: For each concrete mixture, include the following:
   1. Mixture identification.
   2. Compressive strength at 28 days or other age as specified.
   3. Compressive strength required at stages of construction.
   4. Maximum w/cm ratio.
   5. Slump or slump flow limit.
   6. Air content.
   7. Nominal maximum aggregate size.

E. INFORMATIONAL SUBMITTALS

F. Qualification Data: For qualified ready-mix concrete manufacturer.

G. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.

3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

H. Material Test Reports: For each of the following:
1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

I. Preconstruction Test Reports: For each mix design.

J. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Stamped Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
1. Personnel conducting field tests must be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Engineer and of a size directed by the Engineer. Include full-size detectable warning.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.
1. Include the following information in each test report:
a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.

1.06 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 PRODUCTS

2.01 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.02 CONCRETE MATERIALS

A. Source Limitations:
   1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
   2. Obtain each type of admixture from a single manufacturer.

B. Cementitious Materials:
   1. Portland Cement: ASTM C150/C150M, Type I. Type III cement may be used for high-early concrete.
   2. Blended Hydraulic Cement: ASTM C595/C595M, Type IL, Portland-limestone cement.
   3. Performance-Based Hydraulic Cement: ASTM C1157/C1157M: Type HE, high early strength.
   4. Pozzolans: ASTM C618, Class C.

C. Normal-Weight Aggregates:
   1. Coarse Aggregate: ASTM C33/C33M, Size No. 57
   2. Maximum Coarse-Aggregate Size: 1 inch nominal.
   3. Fine Aggregate: ASTM C33/C33M.
      a. Fine aggregate shall be well graded from coarse to fine and, when tested by means of laboratory sieves, shall conform to the following requirements:

Passing	Percent
3/8” Sieve	100
No. 4 Sieve	95 to 100
No. 16 Sieve	50 to 90
No. 50 Sieve	10 to 30
No. 100 Sieve	0 to 10
No. 200 Sieve	0 to 3

         1) Note: Not more than 45% should be retained between any two consecutive sieves.
   4. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
   5. Aggregate Sizes: 1/2 to 3/4 inch nominal.
   6. Aggregate Source, Shape, and Color: as shown in the drawings.

2.03 ADMIXTURES

A. Air-Entraining Admixture: ASTM C260/C260M.

B. Chemical Admixtures: Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
   2. Retarding Admixture: ASTM C494/C494M, Type B.
   3. Accelerating Admixture: ASTM C494/C494M, Type C.
   4. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
   5. Water-Reducing and Accelerating Admixture: ASTM C494/C494M, Type E.
   6. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
   7. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.

C. Mixing Water for Concrete Mixtures and Water Used to Make Ice: ASTM C1602/C1602M. Include documentation of compliance with limits for alkalis, sulfates, chlorides, or solids content of

mixing water from Table 2 in ASTM C1602/C1602M.

2.04 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
   1. Use flexible or uniformly curved forms for curves with a radius as required.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.05 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from steel wire into flat sheets.

B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

C. Reinforcing Bars: ASTM A615/A615M, Grade 60; deformed.

D. Joint Dowel Bars: ASTM A615/A615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.

E. Tie Bars: ASTM A615/A615M, Grade 60; deformed.
   Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.06 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable water that does not cause staining of the surface.

2.07 RELATED MATERIALS

A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber in preformed strips.

2.08 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
   2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Cementitious Materials: Use fly ash as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 25 percent by mass.

C. Concrete Mixtures: Normal-weight concrete.
   1. Class A: Normal-weight concrete for concrete curb, curb and gutter, sidewalks, driveways, drainage, and sewer structures. This is intended to be equivalent to City of Memphis or TDOT Class A concrete.
      a. Minimum Compressive Strength: 3000 psi at 28 days.
      b. Maximum w/cm Ratio: 0.45.
      c. Slump Limit: 4 inches, plus or minus 1 inch.
      d. Air Content: 5-8 percent.
      e. Minimum cement content = 564 lb/CY or 517 lb/CY with limestone coarse aggregate.
   2. Class B: Concrete pavement.
      a. Minimum Compressive Strength: 4000 psi at 14 days.
      b. Maximum w/cm Ratio: 0.45.
      c. Slump Limit: 3 inches, plus or minus 1 inch.
      d. Air Content: 5-8 percent.
      e. Minimum cement content = 620 lb/CY.

D. CONCRETE MIXING
   1. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and

used in the Work.

2. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.03 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.04 INSTALLATION OF STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.05 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 30 feet unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.06 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies or side forms. Use only square-faced shovels for hand spreading and consolidation.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.07 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.08 SPECIAL FINISHES

A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:

1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.

4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

3.09 INSTALLATION OF DETECTABLE WARNINGS

A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Section 321726 "Tactile Warning Surfacing."
   1. Tolerance for Opening Size: Plus 1/4 inch, no minus.

B. Cast-in-Place Detectable Warning Tiles: Form blockouts in concrete for installation of tiles specified in Section 321726 "Tactile Warning Surfacing." Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete to comply with Section 321726 "Tactile Warning Surfacing" immediately after screeding concrete surface.

3.10 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or, a combination of these as follows:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

      Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
   2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:
   1. Elevation: 3/4 inch.
   2. Thickness: Plus 3/8 inch, minus 1/4 inch.
   3. Surface: Gap below 10-feet- long; unleveled straightedge not to exceed 1/2 inch.
   4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
   5. Joint Spacing: 3 inches.
   6. Contraction Joint Depth: Plus 1/4 inch, no minus.
   7. Joint Width: Plus 1/8 inch, no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:
   1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
    a. A compressive-strength test to be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
D. Test results to be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

A. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
B. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
C. Concrete paving will be considered defective if it does not pass tests and inspections.
D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
E. Prepare test and inspection reports.

3.13 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer.
B. Drill test cores, where directed by Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.
C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

DIVISION 32 13 10 – CONCRETE PAVING JOINT SEALANTS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
    1. Joint-sealant backer materials.
    2. Primers.
B. Related Requirements:
    1. *Division 07 92 00* "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.02 ACTION SUBMITTALS

A. Product Data:
   1. Concrete pavement joint sealants.
   2. Joint-sealant backer materials.

B. Paving-Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.
   3. Joint-sealant formulation.
   4. Joint-sealant color.

1.03 QUALITY ASSURANCE

A. Qualifications:
   1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.04 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Performed by a qualified testing agency.

1.05 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 PRODUCTS

2.01 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer.

2.02 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backer materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.03 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.04 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.03 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backers to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of joint-sealant backer materials.
   2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
   3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backer material installation, using proven techniques that comply with the following:
   1. Place joint sealants so they fully contact joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

   Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants in accordance with the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
   4. Remove excess joint sealant from surfaces adjacent to joints.
   5. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

E. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.04 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.05 PAVING-JOINT-SEALANT SCHEDULE

A. Joints within concrete paving and between concrete and asphalt paving:
   1. Joint Location:
      a. Expansion and isolation joints in concrete paving.
      b. Contraction joints in concrete paving.
      c. Joints between concrete and asphalt paving.
      d. Joints between concrete curbs and asphalt paving.
      e. Other joints as indicated.
   2. Joint Sealant: Joint sealant manufactured for the intended use and approved by the Engineer.
   3. Joint-Sealant Color: Color as specified in the drawings. If no color is specified, use a color that matches the adjacent materials.

DIVISION 32 17 00 – TACTILE WARNING SURFACING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

B. Related Requirements:

1. *Division 32 13 00* "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.

C. Samples for Initial Selection: For each type of exposed finish requiring color selection.

D. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

1.03 CLOSEOUT SUBMITTALS

A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 degrees Fahrenheit (37.78 degrees Celsius) and higher.

a. When ambient temperature exceeds 100 degrees Fahrenheit (37.78 degrees Celsius), or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 degrees Fahrenheit (32.22 degrees Celsius), set unit pavers within 1 minute of spreading setting-bed mortar.

1.06 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering and wear.

b. Separation or delamination of materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for tactile warning surfaces.

1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

B. Source Limitations: Obtain each type of tactile warning surfacing from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.02 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:
   1. Furnish Type 304 stainless-steel fasteners for exterior use.
   2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.

B. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.

C. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF TACTILE WARNING SURFACING

A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.

B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.03 CLEANING AND PROTECTION

A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.

B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

DIVISION 32 18 00 – ATHLETIC PAVING AND SURFACE

PART 1 GENERAL

Grading and marking of athletic paving and outdoor surfaces shall be in compliance with National Federation High School Association Standards as adopted by the TSSAA. Copies of the standards are available by contacting the MSCS PM. Detail and specify striping of all play courts provided.

TENNIS COURT SURFACING: Basis of Design shall be 2" asphalt surfacing on 6" compacted stone base course.

TRACK SURFACING: Basis of design for High School tracks shall be rubberized latex surfacing on 2 inches I-2 asphalt surfacing on 6 inches of compacted stone base course. SBR (styrene-butadiene rubber) rubber particles or EPDM (ethylene-propylene-diene rubber) rubber may be used for the surfacing. Middle School tracks shall be 2" asphalt surfacing on 6" compacted stone base course. At Elementary Schools provide oval 220 yd. track with screenings for surface at elementary sites.

OUTDOOR BASKETBALL COURTS AND HARD SURFACE PLAY AREAS: Basis of Design shall be 4" asphalt surfacing on 6" compacted stone base course.

TRACK SURFACING: Track surfacing of new tracks shall slope 2% towards infield to a perimeter drainage system. At existing sites where drainage systems do not exist, it is acceptable to slope 2% away from infield. An alternate shall be provided to incorporate a perimeter drainage system. Two 4" diameter empty conduits with accessible termination boxes shall be provided under track installations for future water and power lines.

TYPICAL SCOPE OF WORK FOR SYNTHETIC TURF AREAS:

- The purpose of this project is to design, prepare, and install a new synthetic turf area that meets safety standards, enhances aesthetics, and provides a durable, low-maintenance surface for children. Construction of a new synthetic turf Area including site preparation, drainage, base construction, turf installation, field markings, and ancillary features to meet all Tennessee standards.
- MSCS will mandate a Design-Build delivery method to be used in construction where a single entity known as the design-builder is responsible for both the design and construction of the New Turf Area project.
- Single Point of Responsibility: The owner contracts with one entity for both design and construction, simplifying communication and accountability.
- Integrated Team: Designers and builders work collaboratively from the beginning, which can lead to better coordination and innovation.
- Faster Delivery: Because design and construction phases can overlap, projects often finish sooner.
- Cost Efficiency: Early collaboration can help control costs and reduce change orders
- Surveying and Layout: Confirm field dimensions and orientation. Survey and mark the designated area.
- Clearing and Grubbing: Remove vegetation, debris, and unsuitable materials. Remove existing surface materials (grass, soil, concrete, etc.).
- Excavation and Grading: Excavate to subgrade and grade for proper drainage. Excavate to required depth for turf system.
- Grade and compact sub-base to ensure proper drainage and stability

Drainage System

- Subsurface Drainage: Install perforated drainage pipes and gravel trenches.
- Stormwater Management: Connect to existing stormwater system or install retention/detention features as required.
- Install subsurface drainage if required
- Ensure proper slope for drainage
- Connect to existing stormwater system or provide alternative drainage solutions

Base Construction

- Subbase Layer: Install compacted crushed stone or aggregate base.
- Laser Grading: Ensure precise leveling for turf installation.
- Install geotextile fabric for weed control.
- Lay and compact crushed stone or aggregate base (typically 4–6 inches).
- Ensure proper slope for drainage

Synthetic Turf Installation

- Turf System: Supply and install approved synthetic turf system with infill (e.g., rubber, sand).
- Seaming and Adhesives: Secure turf panels with appropriate adhesives and seam tape.
- Infill Distribution: Evenly distribute infill material to manufacturer specifications.
- Supply and install synthetic turf designed for use.
- Include padding or shock-absorbing underlayment to meet ASTM F1292 impact attenuation standards.
- Seam and secure turf using industry-standard adhesives and techniques.
- Infill turf with appropriate materials (e.g., rubber granules, sand) as specified
- Install perimeter edging (e.g., concrete curbing, timber borders) to contain turf and infill.
- Ensure smooth transitions between turf and adjacent surfaces
- Construct pedestrian paths and ADA-compliant access

Field Markings and Accessories (alternate #1)

- Line Markings: Permanent inlaid markings for soccer field dimensions.
- Goals and Equipment: (alternate #1) Install soccer goals, nets, and corner flags. Install new playground, sports equipment/structures per manufacturer specifications. Ensure equipment is anchored securely and meets safety standards
- Perimeter Fencing: (alternate #1) Optional fencing for safety and security.

Ancillary Work (alternate #2)

- Lighting (if applicable): Install LED sports lighting system.
- Landscaping: Restore surrounding areas with grass, mulch, or other landscaping.

Quality Assurance and Testing

- Compaction Testing: Verify base compaction meets specifications.
- Drainage Testing: Confirm proper water flow and drainage.
- Turf Inspection: Ensure turf installation meets manufacturer and performance standards.
- Permitting, Landscaping outside the designated turf area, Lighting or irrigation systems unless specified. And inspection fees unless otherwise noted will be carried by Controlling Contractor in all cases.
- Clean up site and remove debris daily.

Closeout and Warranty

- Final Walkthrough: Conduct inspection with stakeholders Inspect turf and equipment installation for compliance with safety and quality standards.
- Documentation: Provide warranties, maintenance manuals, and as-built drawings.
- Training: Offer basic maintenance training to facility staff.
- Provide maintenance guidelines and warranty documentation.

DIVISION 32 18 10 – SYNTHETIC TRACK SURFACING SYSTEM

PART 1 GENERAL

1.01 SCOPE

A. The synthetic surfacing contractor shall furnish all labor, materials, equipment, supervision, and services necessary for the proper completion of all BSS 100 Synthetic Track Surfacing and related work indicated on the drawings and specified herein.

B. The synthetic surfacing contractor shall refer to the drawings for the required locations of synthetic track surfacing to be installed. All quantities and dimensions shall be field verified by the synthetic surfacing contractor.

1.02 SPECIFIC SCOPE OF WORK

A. Install a World Athletics (WA) approved, porous polyurethane synthetic track system comprised of a base layer of polyurethane-bound SBR granules and topped with BEYPUR, a single-component polyurethane structural spray, and EPDM granules.

B. Layout and paint all track lines and event markings as required and specified by current WA, NCAA and NFHS rules.

1.03 COORDINATION

A. The synthetic surfacing contractor shall coordinate the work specified with an authorized and appointed representative of the owner so as to perform the work during a period and in a manner acceptable to the owner.

1.04 APPLICABLE PUBLICATIONS

A. Codes and standards follow the current guidelines set forth by World Athletics (WA) and the National Collegiate Athletic Association (NCAA).

B. State of California Department of Public Health (CDP Standard Method V1.1, Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers Version 1.1, dated February 2010

C. UL-2818 – GREENGUARD Certification Program for Chemical emissions for Building Materials, Finishes and Furnishings; March 29, 2013.

1. The GREENGUARD Gold Certification standard includes health-based criteria for chemicals and requires low VOC emission levels to help ensure that products are acceptable for use in environments like schools and healthcare facilities.
2. GREENGUARD Gold Certifications provide evidence of indoor-air-emissions testing according to stringent requirements exceeding the State of California indoor air quality for schools and GSA standards. GREENGUARD Gold certifications fulfill the credit requirements of LEED and other high-performance building programs for low-emitting products.

1.05 PERFORMANCE STANDARDS

A. The BSS 100 Basemat with Polyurethane Structural Spray Track Surfacing System shall exhibit the following minimum performance standards as required by WA:
   1. Thickness: 13mm or as specified by WA
   2. Shock Absorption: 35 to 50%
   3. Vertical Deformation: 0.6 to 2.5mm
   4. Friction: > 0.5 (47 TRRL Scale)
   5. Tensile Strength: > 58 psi
   6. Elongation at Break: > 40%

1.06 QUALITY ASSURANCE

A. The CONTRACTOR and the MANUFACTURER must be the same.
B. The CONTRACTOR and the MANUFACTURER must have a minimum of 10 years' experience in the manufacturing and installation of the same polyurethane structural spray synthetic track surfacing system specified.
C. The CONTRACTOR shall be able to furnish evidence that they have been in business for a period of not less than 5 years, under the present name, and if required, furnish financial statements for each of the past 5 years.
D. The CONTRACTOR must have installed a minimum of 10 outdoor track facilities in the last 3 years using the exact, WA certified, synthetic track surfacing, as specified herein with the contractor bidding this project.
E. The MANUFACTURER must have a minimum of 10 years of experience compounding two-part polyurethane for athletic surfaces.
F. The CONTRACTOR is required to provide documentation that shows the selected specified and installed product meets current WA Performance Standards for Synthetic Surfaced Athletics Tracks (Outdoor) and is certified in terms of the WA certification system as updated to present day.
G. CONTRACTOR is to provide a list of completed facilities, minimum of 10 which are certified to meet WA/NCAA rules & regulations, utilizing the same product as specified.
H. Specified Surfacing System must be UL Environment GREENGUARD Gold Certified.
I. The MANUFACTURER must offer a minimum of nine (9) GreenGuard Gold Certified Synthetic Track Surfacing Systems.
J. The MANUFACTURER must offer a minimum of nine (9) WA Certified Track Systems.
K. All polyurethane components must be MANUFACTURED in the United States in the MANUFACTURERS own ISO 9001:2015 Certified QMS Facility to ensure the highest quality materials.
L. The CONTRACTOR must have installed a minimum of five (5) Class I WA Certified outdoor tracks within the United States.

1.07 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Standard printed specifications of the synthetic track surfacing system to be installed on this project.
C. An affidavit attesting that the synthetic track surfacing material to be installed meets the requirements defined by the manufacturers currently published specifications and any modifications outlined in those technical specifications.
D. A synthetic track surfacing system sample of the same synthetic track surfacing system to be installed on this project.
E. A list of completed facilities, including the installing supervisor, of the exact synthetic track surfacing system.
F. GreenGuard Gold Product Certification.
G. A current WA Certificate proving the product to be installed meets the current WA Performance Standards for Synthetic Surfaced Athletics Tracks (Outdoor).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Beynon Sports; BSS 100 Basemat with Polyurethane Structural Spray Track System: www.beynonsports.com.
B. Approved Equal.

C. Substitutions: See *Division 01 60 00* - Product Requirements.

2.02 PRIMERS

A. Primers shall be BEYPRIM, a polyurethane-based primer specifically formulated to be compatible with the paved-in-place SBR granules and BEYPUR track surfacing material.

2.03 BLACK SBR GRANULES

A. The rubber granules for the base mat shall be recycled SBR rubber, processed and chopped to 1-3mm size, containing less than 1% dust.

2.04 EPDM GRANULES

A. The rubber granules for the BEYPUR structural spray wearing coats shall be EPDM, synthetic rubber containing a minimum 20% EPDM resin, with a specific gravity of 1.5 □ 0.1 g/cm3. The EPDM rubber shall be the same color as chosen by the owner for the track surface.

2.05 POLYURETHANE BINDER

A. Binder for the black mat shall be BEYPUR, an MDI-based single-component, polyurethane binding agent. The binder shall not have a free TDI monomer level above 0.2% and must be solvent free. The binder must be specially formulated for compatibility with SBR rubber crumb.

2.06 STRUCTURAL SPRAY COATING

A. The spray coating shall be BEYPUR, an MDI-based single-component, moisture cured, high solids, pigmented polyurethane, specifically formulated for compatibility with EPDM granules. The coating shall be the color specified by the owner. Pigment intergraded in the field shall not be allowed.

2.07 LINE MARKING PAINT

A. Manufacturers recommended pigmented line paint.

PART 3 EXECUTION

3.01 SUBBASE REQUIREMENTS

A. Asphalt Compaction
   1. The Synthetic Track Surfacing System shall be laid on an approved subbase. The General Contractor shall provide compaction test results of 92-96% for the installed subbase and asphalt surface.
   2. For certification the following criteria must be followed. The track surface, i.e. asphalt substrate, shall not vary from planned cross slope by more than +/- 0.2%, with a maximum lateral slope outside to inside of 1% for NCAA and 2% for NFHS, and a maximum slope of 0.1% in any running direction. The finished asphalt shall not vary under a 10' straight edge more than 1/8”.
   3. It should be the responsibility of the asphalt-paving contractor to flood the surface immediately after the asphalt is capable of handling traffic. If, after 20 minutes of drying time, there are birdbaths evident, it shall be the responsibility of the architect, in conjunction with the surfacing contractor, to determine the method of correction. No cold tar patching, skin patching or sand mix patching will be acceptable.

B. Asphalt Quality
   1. No Recycled Asphalt Pavement (RAP) shall be used in the wear course asphalt mix design as the inclusion of RAP as an off-set to virgin asphalt binder results in a brittle hot-mix asphalt (HMA) with significantly lower tensile strength and fatigue resistance. The sports surfacing contractor will not be held responsible for asphalt failures resulting from the inclusion of RAP in the HMA mix design of the wear course.
   2. Any oil spills (hydraulic, diesel, motor oil, etc.) must be completely removed, either by chipping out or removing and replacing with new, keyed in asphalt. The minimum depth of any asphalt replacement shall be one inch. The curing time for the asphalt base is 28 days.

C. Responsibility of Others
   1. It shall be the responsibility of the general contractor to determine if the asphalt substrate meets all design specifications, i.e. cross slopes, planarity and specific project criteria. After all the above conditions are met, the synthetic surfacing contractor must, in writing, accept the planarity of the asphalt receiving base, before work can commence.

3.02 THICKNESS

A. The thickness of the BSS 100 Basemat Structural Spray Synthetic Track Surfacing System shall be 13mm.

3.03 EQUIPMENT

A. The BSS 100 Basemat Structural Spray Synthetic Track Surfacing System components shall be processed and installed by specially designed machinery and equipment. A mechanically operated paver with variable regulated speed and thermostatically controlled screed shall be used in the installation of the base mat. The wearing course shall be installed using automatic electronic portioning, which provides continuous mixing and feeding for an accurate, quality controlled installation.

B. No hand mixing is allowed.

3.04 INSTALLATION

A. Base Course

1. The SBR granules and BEYPUR shall be mixed together on site to regulate the ratio/quantity of SBR, not to exceed 82% by weight in the base mat portion of the system. The single component polyurethane binder shall be mixed with the SBR rubber so that a minimum of 18%, by weight, exists in the final mixture. This mixture is then mechanically installed using the paver.

B. Wearing Course

1. The 0.5-to-0.06-inch EPDM granules shall be mixed with BEYPUR, the single-component structural spray coating. The structural spray shall be applied in two (2) uniform applications.

3.05 SITE CONDITIONS

A. Installation shall not take place if adjacent or concurrent construction generates excessive dust, abrasives or any other by-product that, in the opinion of the installer, would be harmful to the track material, until completion of such works.

B. Apply Synthetic Track Surfacing in dry weather when pavement and atmospheric temperatures are forty-five (45) degrees Fahrenheit or above.

C. The maximum temperature cannot exceed 105 degrees at any point during a 24-hour period.

D. Rain cannot be falling. If there is a threat of rain, work shall cease until dry conditions can be re-established on the track pavement. Work is to proceed only when adequate curing can be guaranteed by the manufacturer.

3.06 LAYOUT

A. Line striping and event markings shall be laid out in accordance with current

1. WA, NCAA and NFHS rules.

3.07 CERTIFICATION

A. Upon completion of the installation, the owner shall be supplied with all necessary computations and drawings, as well as a letter of certification attesting to the accuracy of the markings.

3.08 GUARANTEE

A. The BSS 100 Track Surfacing System shall be fully guaranteed against faulty workmanship and material failure for a period of five (5) years from the date of acceptance.

B. The warranty shall be fully third-party insured; prepaid for the entire five (5) year term and be non-prorated. The insurance policy must be underwritten by an “AM Best” A rated carrier.

C. Synthetic surfacing material found to be defective as a result of faulty workmanship and/or material failure shall be replaced or repaired at no charge, upon written notification within the guarantee period.

DIVISION 32 31 00 – FENCING

GENERAL

Fencing is required for security around exterior mechanical equipment areas. It may be installed for security and sport function at tennis courts, high school baseball and softball fields. Where equipment enclosure fencing is adjacent to main buildings, it is desirable for fence construction to match building construction.

CHAIN LINK FENCING: Black LLDPE/PVC coated steel chain link fence and gates with all accessories, fittings, and fastenings, including bottom tension wire, to be obtained from the fence manufacturer. Fabric of fence shall have knuckled selvage at both top and bottom. Do not extend fabric above top rail. Install selvage at base of fence.

MECHANICAL EQUIPMENT AREAS: Shall be enclosed with a fence, a minimum of 6’-0 high. Provide clearance around equipment as required for service and operation. Gates shall be a minimum of 4'-0 wide. Fence posts shall be installed within the concrete slab provided around and under the equipment. Provide enclosure size sufficient for all required maintenance activities.

PRE-K PLAY AREA: Basis of Design shall be enclosed with a 4’-0” high chain link fence.

CLASSROOM/ AUXILIARY ADDITIONS: Walkways between buildings that are exposed to public access shall be secured with fencing and gates. Gates shall be controlled access and include gates for lawn care equipment and large vehicular access. Fence type may be monumental if fencing can be seen from public streets.

DIVISION 32 31 10 – CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fence framework, fabric, and accessories.
B. Excavation for post bases; concrete foundation for posts.
C. Manual gates and related hardware.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Concrete anchorage for posts.
B. *Division 08 71 00* - Door Hardware: Gate locking device.

1.03 PRICE AND PAYMENT PROCEDURES

A. Fences and gates will be provided by the unit price method.
B. Fencing: Measurement and payment by the linear foot (meter), to the fence height specified, based on the specified post spacing. Includes posts, post footings, rails, tension wire, fabric, accessories, attachments.
C. Gates: Measurement and payment each specified type. Includes frame posts, fabric, accessories, hardware.
D. Corner post, end post, and in-line pull posts measurement and payment by each. Includes post, rails, tension wire, braces, stretcher bars, footings, and accessories.

1.04 REFERENCE STANDARDS

A. CLFMI CLF 244 - Project Manual; 1997
B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
D. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a.
E. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
F. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2011.
G. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2018 (Reapproved 2022).

1.05 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.
D. Manufacturer's Installation Instructions: Indicate installation requirements post foundation anchor bolt templates.
E. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Chain Link Fences and Gates:
   1. The manufacturer shall be an active member of the Chain Link Fence Manufacturers Institute (CLFMI).

2.02 MATERIALS AND COMPONENTS

A. Materials and Components: Conform to CLFMI CLF 2445.
B. Fabric Size: CLFMI Heavy Industrial service.
C. Intermediate Posts: Group IA, Regular or High Strength, Group IC, Electric Resistance Weld, and Group II, Rolled Formed C Line Post.
D. Terminal, Corner, Rail, Brace, and Gate Posts: Group IA, Regular or High Strength and Group IC, Electric Resistance Weld.
E. Gates: See plans for size.
   1. Swing Gates
      a. Swing Gates: Galvanized steel pipe welded fabrication in compliance with ASTM F900. Gate frame members 1.900 in. OD (48.3 mm) [ASTM F 1083 schedule 40 galvanized steel pipe] [ASTM F1043 Group IC WT 40 galvanized steel pipe]. Frame members spaced no greater than 8 ft. (2440 mm) apart vertically and horizontally. Welded joints protected by applying zinc-rich paint in accordance with ASTM Practice A780. Positive locking gate latch, pressed steel galvanized after fabrication. Galvanized malleable iron or heavy gauge pressed steel post and frame hinges. Provide lockable drop bar and gate holdbacks with double gates. Match gate fabric to that of the fence system. Gateposts per ASTM F1083 schedule 40 galvanized steel pipe. [Polymer coated gate frames and gateposts; match the coating type and color to that specified for the fence framework.] [Moveable parts such as hinges, latches and drop rods may be field coated using a liquid polymer touch up.] Electrically operated gates must comply with ASTM F2200 and UL325.
      b. Gateposts: Regular Grade ASTM F1083 Schedule 40 pipe.

Gate fabric height up to and including 8 ft. (1.2m)		
Gate leaf width	**Post Outside Diameter**	**Weight**
up to 4 ft. (1.2 m)	2.375 in. (60.3 mm)	3.65 lb/ft (5.4 kg/m)
over 4 ft. to 10 ft. (1.2 to 3.05 m)	2.875 in. (73.0 mm)	5.79 lb/ft (8.6 kg/m)
over 10 ft. to 18 ft. (3.05 to 5.5 m)	4.000 in. (101.6 mm)	9.11 lb/ft (13.6 kg/m)
Gate fabric height over 6 ft. to 12 ft. (1.2 to 2.4m)		
up to 6 ft. (1.8 m)	2.875 in. (73.0 mm)	5.79 lb/ft (8.6 kg/m)
over 6 ft. to 12 ft. (1.8 to 3.7 m)	4.000 in. (101.6 mm)	9.11 lb/ft (13.6 kg/m)
over 12 ft. to 18 ft. (2.4 to 5.5 m)	6.625 in. (168.3 mm)	18.97 lb/ft (28.2 kg/m)
over 18 ft. to 24 ft. (5.5 to 7.3 m)	8.625 in. (219.1 mm)	28.58 lb/ft (42.5 kg/m)

2.03 MATERIALS

A. Posts, Rails, and Frames: ASTM F1083 Schedule 40 hot-dipped galvanized steel pipe, welded construction, minimum yield strength of 30 ksi (205 MPa).
B. Wire Fabric: ASTM A392 zinc coated or ASTM A491 aluminum coated commercial quality steel chain link fabric.
C. Concrete: Ready-mixed, complying with ASTM C94/C94M; normal Portland cement; 3,000 psi strength at 28 days, 3-inch slump; one-inch nominal size aggregate.

2.04 COMPONENTS

A. Line Posts: 1.9-inch, 2.375-inch, 3.500-inch, 2.875 inch, or 4.000-inch diameter.
B. Corner and Terminal Posts: 2.375-inch, 2.875-inch, 3.500 inch, and 4.000 inch.

C. Gate Posts: 3.500-inch, 4.500 inch, and 6.625-inch diameter.
D. Top and Brace Rail: 1.660-inch diameter, plain end, sleeve coupled.
E. Gate Frame: 1.660-inch diameter for welded fabrication.
F. Fabric: 2-inch (51 mm) diamond mesh interwoven wire, 6 gage, 0.1620 inch (4.12 mm) thick, top selvage knuckle end closed, bottom selvage twisted tight.
G. Tension Wire: 7 gage thick steel, single strand.
H. Tension Band: Galvanized pressed steel, minimum thickness 12 gauge (0.105 inch), minimum width 3/4 inch.
I. Tension Bars: Galvanized steel one-piece length 2 inches less than fabric height. Bar sized appropriate for fabric mesh size.
J. Tie Wire: Aluminum alloy 9-gauge steel wire.

2.05 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.
C. Extension Arms: Cast steel galvanized, to accommodate 3 strands of barbed wire, single arm, vertical.
D. Hardware for Single Swinging Gates: 180-degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position.
E. Hardware for Double Swinging Gates: 180-degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.

2.06 FINISHES

A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot (530 g/sq m).
B. Components and Fabric: Vinyl coated over coating of 1.8 ounces per square foot galvanizing (over coating of 550 g/sq m galvanizing).
C. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
D. Accessories: Same finish as framing.
E. Color(s): To be selected by Architect/Engineer from manufacturer's standard range.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567 and details.
B. Place fabric on outside of posts and rails.
C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
D. Line Post Footing Depth Below Finish Grade: ASTM F567.
E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.
F. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.
G. Provide top rail through line post tops and splice with 6 inch (150 mm) long rail sleeves or swedged at one end.
H. Install center brace rail on corner gate leaves.
I. Do not stretch fabric until concrete foundation has cured 28 days.
J. Stretch fabric between terminal posts or at intervals of 100 feet (30 m) maximum, whichever is less.
K. Position bottom of fabric 2 inches (50 mm) above finished grade.
L. Fasten fabric to top rail, braces, and bottom tension wire with tie wire at maximum 18 inches on centers. Fasteners to line post at maximum 12 inches on center.
M. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
N. Install bottom tension wire stretched taut between terminal posts.
O. Install support arms sloped inward and attach barbed wire; tension and secure.
P. Do not attach the hinged side of gate to building wall; provide gate posts.
Q. Install support arms sloped inward and attach barbed wire; tension and secure.
R. Provide concrete center drop to footing depth and drop rod retainers at center of double gate

openings.

S. Install gate locking device specified in Section 08 7100.

3.02 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm).

B. Maximum Offset From True Position: 1 inch (25 mm).

C. Do not infringe on adjacent property lines.

DIVISION 32 31 20 – DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Decorative steel fences.

B. Decorative aluminum fences.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete.

1.03 PRICE AND PAYMENT PROCEDURES

A. Allowances: See Section 01 2100 - Allowances, for cash allowances affecting this section.

1.04 REFERENCE STANDARDS

A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2016.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

E. ASTM D523 - Standard Test Method for Specular Gloss; 2014 (Reapproved 2018).

F. ASTM D714 - Standard Test Method for Evaluating Degree of Blistering of Paints; 2002 (Reapproved 2017).

G. ASTM D822/D822M - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings; 2013 (Reapproved 2018).

H. ASTM D1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments; 2008, with Editorial Revision (2017).

I. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2023.

J. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2024).

K. ASTM D3359 - Standard Test Methods for Rating Adhesion by Tape Test; 2023.

L. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets; 2016 (Reapproved 2023).

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to start of work of this section; require attendance by affected installers.

1.06 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings:

1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
2. Foundation details, concrete design mix and reinforcing schedule for anti-ram barrier system.

D. Samples: Paint color samples for color selection.

E. Manufacturer's Warranty.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years' documented experience.

B. Installer Qualifications: Experienced with type of construction involved and materials and techniques specified and approved by fence manufacturer.

1.08 DELIVERY, STORAGE AND HANDLING

A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

B. Obtain fencing and gate materials, including accessories, fittings, and fastenings, from a single source.

1.09 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Decorative Metal Fences and Gates:
   1. Ameristar Perimeter Security, USA: www.ameristarfence.com.
   2. Substitutions: See *Division 01 60 00* - Product Requirements.

B. Specialty Hardware:
   1. DAC Industries, Inc; Detex Exit Bar: www.dacindustries.com/#sle.
   2. D&D Technologies USA, Inc: www.ddtech.com/#sle.

2.02 FENCES

A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:

B. Electro-Deposition Coating: Multistage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
   1. Total Coating Thickness: 2 mils (0.058 mm), minimum.
   2. Color: As shown on drawings.
   3. Coating Performance: Comply with general requirements of ASTM F2408.
      a. Adhesion: ASTM D3359 (Method B); Class 3B with 90 percent or more of coating remaining in tested area.
      b. Corrosion Resistance: ASTM B117, ASTM D714 and ASTM D1654; 1/8 inch (15.8 mm) coating loss or medium No.8 blisters after 1,500 hours.
      c. Impact Resistance: ASTM D2794; 60 inch pounds (6.8 N m).
      d. Weathering Resistance: ASTM D523, ASTM D822/D822M and ASTM D2244; less than 60 percent loss of gloss.

C. Steel: ASTM A653/A653M; tensile strength 45,000 psi (310 MPa), minimum.
   1. Hot-dip galvanized; ASTM A653/A653M, G60.
   2. 62 percent recycled steel, minimum.

D. Aluminum: ASTM B221.
   1. Tubular Pickets, Rails and Posts: 6005-T5 alloy.
   2. Extrusions for Posts and Rails (Outer Channel): 6005-T5 alloy.
   3. Extrusions for Pickets and Rail (Inner Slide Channels): 6063-T5 alloy.

E. Fasteners: ASTM A276/A276M, Type 302 stainless steel; finished to match fence components.
   1. Tamper-proof security bolts.
   2. Self-drilling hex-head screws.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Set fence posts in accordance with the manufacturer recommended spacing.

C. When cutting rails immediately seal the exposed surfaces by:
   1. Removing metal shavings from cut area.
   2. Apply zinc-rich primer to thoroughly cover cut edge and drilled hole; allow to dry.

3. Apply two coats of custom finish spray paint matching fence color.
4. Failure to seal exposed surfaces in accordance with manufacturer's instructions will negate manufacturer's warranty.

D. Space gate posts according to the manufacturers' drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected.
1. Base type and quantity of gate hinges on the application, weight, height, and number of gate cycles.
2. Identify the necessary hardware required for the application on the manufacturer's gate drawings.
3. Provide gate hardware by the manufacturer of the gate and install in compliance with manufacturer's recommendations.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6.3 mm).
B. Maximum Offset From Indicated Position: 1 inch (25.4 mm).
C. Minimum Distance from Property Line: 6 inches (152 mm).

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.
B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.
C. Post Settings: Randomly inspect three locations against design for:
1. Hole diameter.
2. Hole depth.
3. Hole spacing.
D. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.
E. Gates: Inspect for level, plumb, and alignment.
F. Workmanship: Verify neat installation free of defects.

3.06 CLEANING

A. Leave immediate work area neat at end of work day.
B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
C. Clean fence with mild household detergent and clean water rinse well.
D. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.
E. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

3.07 CLOSEOUT ACTIVITIES

A. See *Division 01 79 00* - Closeout Submittals, for closeout submittals.
B. See *Division 01 80 00* - Demonstration and Training, for additional requirements.

3.08 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

DIVISION 32 32 00 – SEGMENTAL RETAINING WALLS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes concrete paving including the following:
1. Segmental retaining walls.
B. Related Requirements:
1. *Division 31 20 00* "Earth Moving" for excavation for segmental retaining walls, base material, soil fill, fill placement and compaction, and field in-place density testing.

1.02 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct a conference at the Project site.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product

B. Shop Drawings:
   1. Show sizes, profiles, coursing, and locations of retaining wall units; including backfill and leveling base materials.
   2. Show types, sizes, and locations of soil reinforcing materials.
   3. Signed and sealed by the qualified Professional Engineer, registered in Tennessee, responsible for their preparation.
C. Samples for Initial Selection: Manufacturer's standard color sheets, showing the full range of available colors and textures for segmental retaining wall units.
D. Samples for Verification: Actual sample of finished products for each type of exposed finish of segmental retaining wall units Qualification Data: For qualified ready-mix concrete manufacturer.
   1. Size: full-size units.
E. Delegated Design Submittals: For segmental retaining walls, including calculations and analysis data signed and sealed by the qualified Professional Engineer, registered in Tennessee, responsible for their preparation.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.
B. Product Certificates: For each type of segmental retaining wall unit and soil reinforcement from the manufacturer.
   1. Include test data for shear strength between segmental retaining wall units in accordance with ASTM D6916.
   2. Include test data for connection strength between segmental retaining wall units and soil reinforcement in accordance with ASTM D6638.
C. Test and Evaluation Reports:
   1. Product Test Reports: For each type of segmental retaining wall unit and soil reinforcement for tests performed by a qualified testing agency.
   2. Research Reports: For segmental retaining wall system, from ICC-ES, or other Engineer-approved agencies, showing compliance with building code requirements.
   3. Preconstruction Test Reports: For segmental retaining wall units and soil reinforcement.
D. Source Quality-Control Submittals:
   1. Source quality-control reports.
E. Field Quality-Control Submittals:
   1. Field quality-control reports.
F. Qualification Statements: For testing agency.
G. Delegated design engineer qualifications.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Installers: Entity that employs installers certified under the National Concrete Masonry Association (NCMA) Certified Segmental Retaining Wall Installer program at the Basic certification level.
   2. Delegated Design Engineer: A Professional Engineer who is legally qualified to practice in Tennessee and who is experienced in providing engineering services of the type indicated.
   3. Testing Agency: Qualified in accordance with ASTM E329 for testing indicated.

1.06 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects.
   1. Build mockup of segmental retaining wall approximately 72 inches long by not less than 36 inches high above finished grade at front of wall.
      a. Include typical soil reinforcement.
      b. Include typical base and cap or finished top construction.
      c. Include backfill to typical finished grades at both sides of wall.
      d. Include typical end construction at one end of mockup.
      e. Include 36-inch return at one end of mockup, with typical corner construction.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at the time of Substantial Completion.

1.07 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform the following

preconstruction testing:

1. Test soil reinforcement and backfill materials for pullout resistance in accordance with ASTM D6706.
2. Test soil reinforcement and backfill materials for coefficient of friction in accordance with ASTM D5321/D5321M.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store and handle concrete units and accessories to prevent deterioration or damage due to contaminants, breaking, chipping, or other causes.

B. Store geosynthetics in the manufacturer's original packaging with labels intact. Store and handle geosynthetics to prevent deterioration or damage due to sunlight, chemicals, flames, temperatures above 160 deg F or below 32 deg F, and other conditions that might damage them. Verify identification of geosynthetics before use and examine them for defects as the material is placed.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in *Division 01 40 00* "Quality Requirements," to design segmental retaining walls.

B. Compliance Review: Qualified professional engineer responsible for segmental retaining wall design shall review and approve submittals and source and field quality-control reports for compliance of materials and construction with design.

C. Structural Performance: Engineering design shall be based on the following loads and be in accordance with NCMA's "Design Manual for Segmental Retaining Walls" or the 2015 version of the INTERNATIONAL BUILDING CODE as required in Shelby County, whichever is more stringent.

1. Loads due to gravity and soil pressures resulting from grades indicated in the drawings.
   a. See the Project Geotechnical report for retaining wall design lateral earth pressures.
2. Horizontal Peak Ground Acceleration for Project.
   a. See the Project Geotechnical report for site classification and seismic design parameters.

2.02 SEGMENTAL RETAINING WALL UNITS

A. Color: As selected by Architect from the manufacturer's full range.

B. Shape and Texture:

1. Provide units with textured face as required by the Architect.
   a. Face Dimensions:
      1) As indicated in drawings or required by the Architect.
      2) Provide units matching basic shape, dimensions, and face texture of basis-of-design product.
      3) Provide units of any basic shape and dimensions that produce segmental retaining walls of dimensions and profiles indicated without interfering with other elements of the Work and with a machine-split textured.

C. Batter: Provide units that offset from the course below to provide batter based on design.

D. Cap Units: Provide cap units of shape indicated in the drawings with smooth, as-cast top surfaces without holes or lugs.

E. Special Units: Provide corner units, end units, and other shapes as needed to produce segmental retaining walls of dimensions and profiles indicated and to provide texture on exposed surfaces as indicated.

2.03 INSTALLATION MATERIALS

A. Pins: Product supplied by segmental retaining wall unit manufacturer for use with units provided, made from non-degrading polymer reinforced with glass fibers.

B. Clips: Product supplied by segmental retaining wall unit manufacturer for use with units provided, made from non-degrading polymer reinforced with glass fibers.

C. Cap Adhesive: Product supplied or recommended by segmental retaining wall unit manufacturer for adhering cap units to units below.

D. Leveling Base: Comply with requirements in Section 312000 "Earth Moving" for drainage course.

1. Leveling Course: Lean concrete with a compressive strength of not more than 500 psi.

E. Drainage Fill: Comply with requirements in Section 312000 "Earth Moving" for drainage course.

F. Reinforced Soil Fill:
    1. ASTM D2487; GW, GP, SW, SP, and SM soil classification groups or a combination of these groups; free of debris, waste, frozen materials, vegetation, and other deleterious matter; complying with the following gradation in accordance with ASTMC136/C136M:
        a. 20 to 100 percent passing No. 4 sieve,
        b. 0 to 60 percent passing No. 40 sieve,
        c. 0 to 35 percent passing No. 200 sieve, and
        d. Fine fraction having a plasticity index of less than 20.
G. Nonreinforced-Soil Fill: Comply with requirements in Section 312000 "Earth Moving" for satisfactory soils.
H. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
I. Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation of greater than 50 percent.
    1. Apparent Opening Size: No. 70 to 100 sieve, maximum; ASTM D4751.
    2. Minimum Grab Tensile Strength: 110 lb; ASTM D4632/D4632M.
    3. Minimum Weight: 4 oz./sq. yd.
J. Soil Reinforcement: Product specifically manufactured for use as soil reinforcement and as follows:
    1. Product Type:
        a. Knitted or woven geogrid made from polyester yarns with a protective coating, or
        b. Molded geogrid made from high-density polyethylene, or
        c. Woven geotextile made from polyamides, polyesters, or polyolefins, or
        d. Manufacturer-recommended and Engineer-approved alternative.

2.04 SOURCE QUALITY CONTROL

A. Factory test and inspect each roll of soil reinforcement for minimum average roll values for geosynthetic index property tests, including the following:
    1. Weight.
    2. Grab or single-rib strength.
    3. Aperture opening.
    4. Rib or yarn size.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for excavation tolerances, condition of subgrades, and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF RETAINING WALLS

A. General: Place units in accordance with NCMA's "Segmental Retaining Wall Installation Guide" and segmental retaining wall unit manufacturer's written instructions.
    1. Lay units in the bond pattern indicated.
    2. Form corners and ends by using special units.
B. Do not use units with chips, cracks, or other defects that are visible at a distance of 20 feet where such defects are exposed in the completed Work.
C. Leveling Base: Place and compact base material to the thickness indicated and with not less than 95 percent maximum dry unit weight in accordance with ASTM D698.
    1. Leveling Course: At Contractor's option, unreinforced lean concrete may be substituted for upper 1 to 2 inches of base. Compact and screed concrete to a smooth, level surface.
D. First Course: Place first course of segmental retaining wall units for full length of wall. Place units in firm contact with each other, properly aligned and level.
    1. Tamp units into leveling base as necessary to bring tops of units into a level plane.
E. Subsequent Courses: Remove excess fill and debris from tops of units in course below. Place units in firm contact, properly aligned, and directly on course below.
    1. For units with lugs designed to fit into holes in adjacent units, lay units so lugs are accurately aligned with holes, and bedding surfaces are firmly seated on beds of units below.

2. For units with lips at front of units, slide units as far forward as possible for firm contact with lips of units below.
3. For units with lips at bottom rear of units, slide units as far forward as possible for firm contact of lips with units below.
4. For units with pins, install pins and align units.
5. For units with clips, install clips and align units.

F. Cap Units: Place cap units and secure with cap adhesive.

3.03 FILL PLACEMENT

A. General: Comply with requirements in Section 312000 "Earth Moving," with NCMA's "Segmental Retaining Wall Installation Guide" and segmental retaining wall unit manufacturer's written instructions.
B. Fill voids between and within units with drainage fill. Place fill as each course of units is laid.
C. Place, spread, and compact drainage fill and soil fill in uniform lifts for full width and length of embankment as wall is laid. Place and compact fills without disturbing alignment of units. Where both sides of wall are indicated to be filled, place fills on both sides at same time. Begin at wall, and place and spread fills toward embankment.
    1. Use only hand-operated compaction equipment within 48 inches of wall or one-half of height above bottom of wall, whichever is greater.
    2. Compact reinforced-soil fill to not less than 95 percent maximum dry unit weight in accordance with ASTM D698.
        a. In areas where only hand-operated compaction equipment is allowed, compact fills to not less than 90 percent maximum dry unit weight in accordance with ASTM D698.
        b. In areas where fill height exceeds 10 feet, compact reinforced-soil fill that will be more than 10 feet below finished grade to not less than 98 percent maximum dry unit weight in accordance with ASTM D698.
    3. Compact nonreinforced-soil fill to comply with Section 312000 "Earth Moving."
D. Place drainage geotextile against back of wall, and place layer of drainage fill at least 12 inches wide behind drainage geotextile to within 12 inches of finished grade. Place another layer of drainage geotextile between drainage fill and soil fill.
E. Wrap subdrainage pipe with filter fabric and place in drainage fill as indicated
F. Place soil reinforcement in horizontal joints of retaining wall where indicated and in accordance with soil-reinforcement manufacturer's written instructions. Embed reinforcement a minimum of 8 inches, or as required by the manufacturer, into retaining wall and stretch tight over compacted backfill. Anchor soil reinforcement before placing fill.
    1. Place additional soil reinforcement at corners and curved walls to provide continuous reinforcement.
    2. Overlap or connect splices between sheets of geosynthetics as required by the manufacturer.
    3. Place geosynthetics with seams, if any, oriented perpendicularly to segmental retaining walls.
    4. Do not dump fill material directly from trucks onto geosynthetics.
    5. Place at least 6 inches of fill over reinforcement before compacting with tracked vehicles or 4 inches before compacting with rubber-tired vehicles.
    6. Do not turn vehicles on fill until first layer of fill is compacted and second layer is placed over each soil-reinforcement layer.

3.04 CONSTRUCTION TOLERANCES

A. Variation from Level: For bed-joint lines along walls, do not exceed 1-1/4 inches in 10 feet, 3 inches maximum.
B. Variation from Indicated Batter: For slope of wall face, do not vary from indicated slope by more than 1-1/4 inches in 10 feet.
C. Variation from Indicated Wall Line: For walls indicated as straight, do not vary from straight line by more than 1-1/4 inches in 10 feet.
D. Maximum Gap between Units: 1/8 inch.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Comply with requirements in Section 312000 "Earth Moving" for field quality control.

C. Tests and Inspections:
   1. In each compacted backfill layer, perform at least one field in-place compaction test for each 150 feet or less of segmental retaining wall length.
   2. Segmental retaining wall system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.06 ADJUSTING

A. Remove and replace segmental retaining wall construction of the following descriptions:
   1. Broken, chipped, stained, or otherwise damaged units. Units may be repaired only if the Engineer approves the methods and results.
   2. Segmental retaining walls that do not match approved Samples or mockups.
   3. Segmental retaining walls that do not comply with other requirements indicated.

B. Replace units so the segmental retaining wall matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.

DIVISION 32 33 00 – SITE FURNISHINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Benches.

B. Bollards.

1.02 RELATED REQUIREMENTS

A. *Division 03 30 00* - Cast-in-Place Concrete: Bollard infill and underground encasement.

B. *Division 05 50 00* - Metal Fabrications: Anchors to attach site furnishings to mounting surfaces.

C. *Division 05 50 00* - Metal Fabrications: Utilitarian concrete filled steel pipe bollards.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

E. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).

F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

G. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.

H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and, and Tubes; 2013.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, and maintenance information.

C. Shop Drawings: Indicate plans for each unit or group of units, elevations with model number, overall dimensions, construction, and anchorage details.

D. Samples: Submit one sets of manufacturer's available colors for metal furnishings.

E. Samples: Submit one sets of manufacturer's available colors and finishes for precast furnishings.

1.05 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer’s warranty against defects in materials or workmanship for ductile iron castings for a period of 10 years from Date of Substantial Completion.

C. Provide manufacturer’s Lifetime Warranty against defects in materials or workmanship for wood benches manufactured from solid teak.

PART 2 PRODUCTS

2.01 PRECAST CONCRETE FURNISHINGS

A. Precast Concrete Furnishings, General:
   1. Precast Concrete Components: Mixture of cement, aggregates, water, and mineral colors;

molded to shape, and reinforced with steel bars.
a. Finish:
1) Horizontal Surfaces: Smooth for seats and table tops.
2) Vertical Surfaces: Smooth for supports and sides.
b. Color: As selected by Architect/Engineer from manufacturer's standard range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify proper installation of mounting surfaces, preinstalled anchor bolts, and other mounting devices; and ready to receive site furnishing items.
B. See *Division 05 50 00* for anchors to attach site furnishings to mounting surfaces.
C. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

A. Install site furnishings in accordance with approved shop drawings, and manufacturer's installation instructions.
B. See *Division 03 30 00* for bollard infill and underground encasement.
C. Provide level mounting surfaces for site furnishing items.

DIVISION 32 84 00 – UNDERGROUND SPRINKLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe and fittings, valves, sprinkler heads, emitters, bubblers, and accessories.
B. Control system.

1.02 RELATED REQUIREMENTS

A. *Division 26 05 19* - Low-Voltage Electrical Power Conductors and Cables.
B. *Division 26 05 00* - Conduit for Electrical Systems.

1.03 PRICE AND PAYMENT PROCEDURES

A. Piping:
1. Basis of Measurement: By the linear foot (meter).
2. Basis of Payment: Includes trenching, placing pipe and fittings, valves, control box, conduit and wiring, and accessories.
B. Sprinkler Heads:
1. Basis of Measurement: By the unit.
2. Basis of Payment: Includes sprinkler head and fittings.

1.04 REFERENCE STANDARDS

A. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
B. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.
C. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
D. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2020.
E. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.
F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with site backfilling, landscape grading and delivery of plant life.
B. Preinstallation Meeting: Convene one week prior to commencing work of this Section.

1.06 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate piping layout to water source, location of sleeves under pavement, location and coverage of sprinkler heads, components, plant and landscaping features, site structures, schedule of fittings to be used.
C. Samples: Provide one outlet of each type, with housing. Accepted samples may be used in the Work.
D. Operation and Maintenance Data:
1. Provide instructions for operation and maintenance of system and controls, seasonal activation and shutdown, and manufacturer's parts catalog.

2. Provide schedule indicating length of time each valve is required to be open to provide a determined amount of water.

E. Maintenance Materials: Provide the following for Owner's use in maintenance of project.
1. Extra Sprinkler Heads: One of each type and size.
2. Extra Valve Keys for Manual Valves: One.
3. Extra Valve Box Keys: One.
4. Extra Valve Marker Keys: One.
5. Wrenches: One for each type head core and for removing and installing each type head.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum of 5 years of experience.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with applicable code for piping and component requirements.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of products in system.

2.02 IRRIGATION SYSTEM

A. Manually controlled underground irrigation system, with low point self-drain.
1. Source Power: 120 volts.
2. Low Voltage Controls: 24 volts.

B. Manufacturers:
1. Rain Bird Sales, Inc: www.rainbird.com.
2. Substitutions: See *Division 01 60 00* - Product Requirements.

2.03 PIPE MATERIALS

A. PVC Pipe: ASTM D2241; 200 psi (1.38 MPa) pressure rated upstream from controls, 160 psi (1.10 MPa) downstream; solvent welded sockets.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A); annealed temper.

C. Copper Pipe: ASTM B42, regular type.

D. Fittings: Type and style of connection to match pipe.

E. Pipe Risers at Valves: 160 psi (1.10 MPa) PVC pipe.

F. Pipe Risers at Valves: 100 psi (0.69 MPa) ABS pipe.

G. Pipe Risers at Valves: 200 psi (1.4 MPa) copper pipe.

H. Solvent Cement: ASTM D2564 for PVC pipe and fittings.

I. Solder and Flux: ASTM B32 solder, with suitable flux.

J. Sleeve Material: PVC.

2.04 OUTLETS

A. Outlets: Brass construction.

B. Rotary Type Sprinkler Head: Fixed type with screens; fully adjustable for flow and pressure; size as indicated; with letter or symbol designating degree of arc and arrow indicating center of spray pattern.

C. Spray Type Sprinkler Head: Fixed surface head.

D. Emitter: Adjustable outlet, non-clogging, with two trickle tubes.

2.05 VALVES

A. Manufacturers:
1. See Plans.
2. Substitutions: See *Division 01 25 00* - Substitution Procedures.

B. Gate Valves: Bronze construction non-rising stem.

C. Backflow Preventers: Iron body construction, double check valve type.

2.06 CONTROLS

A. Manufacturers:
1. See Plans.
2. Substitutions: See *Division 01 25 00* - Substitution Procedures.

B. Controller Housing: NEMA 250 Type 3; weatherproof, watertight, with lockable access door.

C. Valves: Hydraulic; normally open; hydraulic tubing, including required fittings and accessories.

D. Wire Conductors: Color coded.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify location of existing utilities.
B. Verify that required utilities are available, in proper location, and ready for use.

3.02 PREPARATION

A. Piping layout indicated is diagrammatic only. Route piping to avoid plants, ground cover, and structures.
B. Layout and stake locations of system components.
C. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system.

3.03 TRENCHING

A. Trench to accommodate grade changes and slope to drains.
B. Maintain trenches free of debris, material, or obstructions that may damage pipe.

3.04 INSTALLATION

A. Install pipes, valves, controls, and outlets in accordance with manufacturer's instructions.
B. Connect to utilities.
C. Set outlets and box covers at finish grade elevations.
D. Provide for thermal movement of components in system.
E. Slope piping for self-drainage to gravel filled well point.
F. Use threaded nipples for risers to each outlet.
G. Install control wiring in accordance with *Division 26 05 19*. Provide 10-inch (250 mm) expansion coil at each valve to which controls are connected, and at 100 ft (30 m) intervals. Bury conduit beside pipe.
H. Mark valves with neoprene valve markers containing locking device. Set valve markers in pipe risers extending from top of valve to finish grade.
I. After piping is installed, but before outlets are installed and backfilling commences, open valves and flush system with full head of water.

3.05 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01 4000 - Quality Requirements.
B. Prior to backfilling, test system for leakage at main piping to maintain 100 psi (690 kPa) pressure for one hour.
C. System is acceptable if no leakage or loss of pressure occurs and system self-drains during test period.

3.06 BACKFILLING

A. Provide 3-inch (75 mm) sand cover over piping.
B. Backfill trench and compact to specified subgrade elevation. Protect piping from displacement.

3.07 SYSTEM STARTUP

A. Prepare and start system in accordance with manufacturer's instructions.
B. Adjust control system to achieve time cycles required.
C. Adjust head types for full water coverage as directed.

3.08 CLOSEOUT ACTIVITIES

A. Instruct Owner's personnel in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance data as basis for demonstration.

3.09 MAINTENANCE

A. See *Division 01 70 00* - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
B. Provide one complete spring start-up and a fall shutdown by installer, at no extra cost to Owner.

DIVISION 32 90 00 – HYDROSEEDING

PART 1 GENERAL

1.01 DESCRIPTION

A. This section specifies a spray-applied wood fiber mulch used to prevent soil erosion and promote seed germination in hydroseeding.

1.02 RELATED SECTIONS

A. *Division 32 92 00* - Seeding.
B. *Division 32 93 00* - Plants.

PART 2 PRODUCTS

2.01 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions. Include required substrate preparation, list of materials, and application rate.
B. Deliver materials and products in factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage from weather, excessive temperatures, and construction operations.
C. Acceptable manufacturer
    1. Profile Products LLC, 750 Lake Cook Road—Suite 440, Buffalo Grove, IL 60089, 800-366-1180 (Fax 847-215-0577)
    2. Central Fiber Corporation, 4814 Fiber Lane, Wellsville, KS 66092, 800-654-6117
    3. Profile Products LLC, 750 Lake Cook Road—Suite 440, Buffalo Grove, IL 60089 800-654-8793 (Fax 847-215-0577)
    4. Nu-Wool, Inc., 2472 Port Sheldon Road, Jenison, MI 49428, 800-748-0128 (Fax 616-669-2370)
    5. City Engineer approved

2.02 MATERIALS

A. Bonded Fiber Matrix
    1. Conwed Fibers 2500 BFM by Profile Products LLC with the following characteristics:
        a. Materials: Wood fiber, Polysaccharide cross-linked hydro-colloid tackifier, dark green dye.
        b. pH Range: 4.8 plus or minus 2.
        c. Moisture Content: 132+-3% percent maximum.
        d. Wood fiber Content: 90 percent maximum.
        e. Polysaccharide Cross linked Hydro-colloid Polymer Tackifier: 10+-1%
        f. Organic Content: 99 percent, plus or minus 1.
        g. Ash Content: 1 percent, plus or minus 1.
        h. Water Holding Capacity: 1,350 percent minimum.
        i. Fiber Mulch Slurry Viscosity: Minimum 2.85 cps (Test Method: Falling Ball Viscometer) Test condition 1500 lbs of fiber mulch per 3000 gallons of water, evaluated immediately after mixing.
        j. Packaging: 50 pound UV resistant bags, with UV resistant pallet cover.
    2. Spray Matt by Central Fiber Corporation
        a. Materials: Wood fiber tackifier, emerald green dye.
        b. pH Range: 6.5 plus or minus 1.
        c. Moisture Content: 12+-3% percent minimum.
        d. Wood Fiber Content: 90 percent minimum.
        e. Tackifier: maximum 10%
        f. Organic Content: 99 percent, plus or minus 1.
        g. Water Holding Capacity: 1,300 percent minimum.
        h. Packaging: 50 pound UV resistant bags, with UV resistant pallet cover.
B. Wood Cellulose Fiber
    1. Profile Jet-Spray w/ Poly-fibers by Profile Products LLC with the following characteristics:
        a. Materials: Cellulose fiber, clean raw lumber wood chips, polyester fibers, dark green dye.
        b. pH Range: 7.0 plus or minus 2.
        c. Moisture Content: 12% +-3% percent minimum.
        d. Wood Fiber Content: 20% +-2%.

e. Paper Fiber Content: 78% +-2%.
f. Photo Degradable Polyester Fibers: 2% +-.1% (½ to ¾ inch staple lengths: 1.5 denier)
g. Organic Content: 95.0% +-3%.
h. Ash Content: 5.0%+-3%.
i. Water Holding Capacity: 850% minimum.
j. Fiber Mulch Slurry Viscosity: 1.25 cps +-.10 (Test Method: Falling Ball Viscometer) Test condition 1500 lbs of fiber mulch per 3000 gallons of water, evaluated immediately after mixing.
k. Packaging: 40-pound UV resistant bags, with UV resistant pallet cover.

2. HydroGreen Plus by Nu-Wool, Inc. with the following characteristics:
a. Materials: Wood fibers with recycled paper, dark green dye.
b. pH Range: 7.0 plus or minus .4.
c. Moisture Content: 8% +-2% percent maximum.
d. Ash Content: 1.7% maximum.
e. Water Holding Capacity: 900% minimum.
f. Packaging: 40-pound UV resistant bags, with UV resistant pallet cover

PART 3 EXECUTION

3.01 SUBSTRATE PREPARATION

A. Examine substrates and conditions where materials will be applied. Do not proceed with installation until unsatisfactory conditions are corrected.
B. Only apply product to geotechnically stable slopes that have been designed and built to divert the water shed away from the face of the slope, therefore eliminating surface flow energy from above from damaging the slope face.

3.02 INSTALLATION

A. Strictly comply with manufacturer's installation instructions and recommendations. Use approved hydrospraying machines.
B. Apply from opposing directions to soil surface, reducing the "shadow effect" and assures soil surface coverage of a minimum of 99%. Do not exceed maximum slope length of 70 feet when slope gradients are steeper than 4 to 1.
C. Install materials at the following application rate:
1. Hydroseeding Using Bonded Fiber Matrix
a. Apply from opposing directions to soil surface, reducing the "shadow effect" and assures soil surface coverage of a minimum of 99%. Do not exceed maximum slope length of 70 feet when slope gradients are steeper than 4 to 1.
b. Install materials at the following application rate:
Add 30 to 50 pounds of bonded fiber matrix per 100 gallons of water when hydroseeding; confirm loading rates with equipment manufacturer.
Mod to 3 to 1 slope: 3000 pounds per acre
2 to 1 slope: 3500 pounds per acre
3 Greater than 1 to 1 slope: 4000 pounds per acre
2. Hydroseeding Using Wood Cellulose Fiber
a. Do not exceed maximum slope length of 35 feet when slope gradients are steeper than 4 to 1.
b. Install materials at the following application rate:
Add 35 to 50 pounds per 100 gallons of water when hydroseeding; confirm loading rates with equipment manufacturer.
Mod to 4 to 1 slope: 1500 pounds per acre
4 to 1 slope: 2000 pounds per acre
3 to 1 to 2 to 1 slope: 2500 pounds per acre
2 to 1 to 1 to 1 slope: 3000 pounds per acre

DIVISION 32 92 00 – SEEDING

PART 1 GENERAL

The Designer shall require the contractor to stage construction, so all playground and athletic field grass seeding occurs early enough to allow grass to develop through one growing season prior to substantial completion. When substantial completion is scheduled for June through December, grass seeding shall occur prior to April 15. It will be the contractor's responsibility to fertilize, irrigate, and cut the maturing grass until substantial completion. The areas of playground and athletic grass seeding along with scheduled seeding date shall be shown on Designer's Landscape Planting Plans. At renovation/addition projects, the Designer shall require the Contractor to isolate and protect existing lawn areas not involved in the new construction. Sod shall be used within 2'-0" of all new sidewalks and concrete curbs. Seed and straw all other disturbed areas.

LAWN GRASS SEEDING: Shall be 5 pounds of Kentucky 31 Tall Fescue and 1 pound of Kentucky bluegrass per 1,000 SF from September 15 through March 30. From April 1 through June 15 seeding shall be Hulled Common Bermuda at a rate of 2 pounds per 1000 SF.

ATHLETIC FIELD GRASS SEEDING: Shall be composed of sod forming grasses. The best variety for the Davidson County area is Bermuda. The first preference is hybrid Bermuda Tifton 419. The installation of sod has given the best results. Sprigging has been satisfactory when given enough time to establish. Hulled Common Bermuda is next and should be seeded at two (2) lb. per 1,000 SF. This seeding needs the entire growing season from April 15 through August 30 to develop. Annual Rye Grass can be planted during fall and winter months for temporary cover.

IRRIGATION: From time of seeding until grass is established, the Contractor shall keep maturing grass irrigated and cut on a regular basis. Fields shall be irrigated with 1-1.5 inches of water per week. Ideally the water should be applied in two increments, to avoid water run-off. Cutting shall occur when grass is a maximum of 3" tall.

1.01 SECTION INCLUDES

A. Preparation of subsoil.
B. Placing topsoil.
C. Seeding, mulching and fertilizer.
D. Maintenance.
E. Watering.

1.02 PRICE AND PAYMENT PROCEDURES

A. See *Division 01 22 00* - Unit Prices, for additional unit price requirements.
B. Topsoil:
    1. Basis of Measurement: By the cubic yard (meter).
    2. Basis of Payment: Includes striping topsoil, stockpile, and placing topsoil.
C. Grassed Areas:
    1. Basis of Measurement: By the acre.
    2. Basis of Payment: Includes preparation of topsoil, seeding, watering and maintenance to specified time limit.

1.03 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.
B. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.
C. Maintenance Contract.
D. Furnish the Engineer a certified laboratory report showing the analysis of the seed to be furnished. The report shall bear the signature of a senior seed technologist.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

B. Deliver fertilizers in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of seed mixture.

2.02 SEED MIXTURE

A. Seed Mixture:

1. All seeds shall meet the requirements of the Tennessee Department of Agriculture and TDOT Standard Specifications for Road and Bridge Construction (Current Edition).

2.03 SOIL MATERIALS

A. Topsoil: Excavated from site and free of weeds.

2.04 ACCESSORIES

A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

B. Fertilizer: recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated by analysis.

C. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

D. Erosion Fabric: Jute matting, open weave.

2.05 TESTS

A. Provide analysis of topsoil fill under provisions of *Division 01 40 00*.

B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.

C. Submit minimum 10 oz (280 g) sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.

D. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

4.01 EXAMINATION

A. Verify that prepared soil base, is ready to receive the work of this Section.

4.02 PREPARATION

A. Install edging at periphery of seeded areas in straight lines to consistent depth.

4.03 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

D. Mix thoroughly into upper 2 inches (50 mm) of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

4.04 SEEDING

A. Apply seed at a rate recommended by supplier evenly in two intersecting directions. Rake in lightly.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Do not sow immediately following rain, when ground is too dry, or during windy periods.

D. Roll seeded area with roller not exceeding 112 lbs (50 Kg).

E. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches (3 mm). Maintain clear of shrubs and trees.

F. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches (100 mm) of soil.

G. Following germination, immediately re-seed areas without germinated seeds that are larger than

4 by 4 inches (100 by 100 mm).

H. Use Group "A" seed from February 1 to August 1.
I. Use Group "B" seed from August 1 to December 1, with the exception that either Group "A" or "B" may be used during the month of August.
J. Scarify, disc, harrow, rake, or otherwise work each area to be seeded until it has been loosened and pulverized to a depth as directed by the Engineer.
K. Uniformly incorporate fertilizer into the soil for a depth of approximately 1/2" at the rate of:
    1. Not less than 20 pounds per 1000 square feet for grade 10-10-10 or equivalent.
    2. Not less than 100 pounds per 1000 square feet for agricultural limestone.
L. Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment.
M. Sow seed of the specified group as soon as preparation of the seedbed has been completed.
N. Sow uniformly by means of a rotary seeder, hydraulic equipment, or other satisfactory means at the rate of 1 1/2 pounds per 1,000 square feet, unless otherwise specified.
O. Inoculate Group “B” seed and seeds of legumes, when sown alone, before sowing in accordance with the recommendations of the manufacturer of the inoculant.
P. Do not perform seeding during windy weather, or when the ground surface is frozen, wet, or otherwise non-tillable. No seeding shall be performed during December through February unless otherwise permitted.
Q. When specified, provide seeding with mulch:
    1. Spread hay or straw mulch evenly over the seeded area at an approximate rate of 75 pounds per 1,000 square feet immediately following the seeding operations. This rate may be varied by the Engineer, depending on the texture and condition of the mulch material and the characteristics of the area seeded.
    2. Hold hay or straw mulch in place by the use of a mulch binder applied at the approximate rate of 4 gallons per 1,000 square feet as required.
    3. Cover bridges, guardrails, signs, and appurtenances, if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.
    4. When wood fiber mulch is used, uniformly apply at the rate of 28 to 35 pounds per 1,000 square feet with hydraulic mulching equipment.

4.05 PROTECTION

A. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.
B. Lay fabric smoothly on surface, bury top end of each section in 6 inch (150 mm) deep excavated topsoil trench. Provide 12 inch (300 mm) overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.
C. Secure outside edges and overlaps at 36-inch (900 mm) intervals with stakes.
D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches (150 mm).

4.06 MAINTENANCE

A. Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.
B. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches (65 mm). Do not cut more than 1/3 of grass blade at any one mowing.
C. Neatly trim edges and hand clip where necessary.
D. Immediately remove clippings after mowing and trimming.
E. Water to prevent grass and soil from drying out.
F. Roll surface to remove minor depressions or irregularities.
G. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
H. Immediately reseed areas that show bare spots.
I. Protect seeded areas with warning signs during maintenance period.

DIVISION 32 92 10 – SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparation of subsoil.
B. Placing topsoil.
C. Fertilizing.
D. Sod installation.
E. Maintenance.

1.02 PRICE AND PAYMENT PROCEDURES

A. Topsoil:
   1. Basis of Measurement: By the cubic yard (meter).
   2. Basis of Payment: Includes topsoil, placing topsoil.
B. Sodded Areas:
   1. Basis of Measurement: By the square yard (meter).
   2. Basis of Payment: Includes preparation of subsoil, placing topsoil, sodding, watering and maintenance to specified time limit.

1.03 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 REFERENCE STANDARDS

A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

1.05 SUBMITTALS

A. Certification: Submit certification of grass species and location of sod source.
B. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.06 QUALITY ASSURANCE

A. Sod Producer: Company specializing in sod production and harvesting with minimum five years' experience, and certified by the State of TN.
B. Installer Qualifications: Company approved by the sod producer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver sod on pallets. Protect exposed roots from dehydration.
B. Do not deliver more sod than can be laid within 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.
B. Provide certificate of compliance from authority having jurisdiction indicating approval of fertilizer and herbicide mixture.

2.02 MATERIALS

A. Sod: TPI (SPEC), Certified Turfgrass Sod quality; cultivated grass sod; type indicated in plant schedule on Drawings; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq ft (100 sq m). Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
   1. Thickness: "Thin" sod, min. 1/2-inch (13 mm) and max. 1 inch (25 mm) topsoil base.
   2. Thickness: "Thick" sod, minimum 1 inch (25 mm) and maximum 1-3/8-inch (35 mm) topsoil base.
   3. Cut sod in area not exceeding 1 sq yd (1 sq m).
   4. Machine cut sod and load on pallets in accordance with TPI (SPEC) Guidelines.
B. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay, or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.
C. Topsoil: Excavated from site and free of weeds.
D. Fertilizer: Recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil.

E. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

2.03 ACCESSORIES

A. Wood Pegs: Softwood, sufficient size and length to ensure anchorage of sod on slope.
B. Wire Mesh: Interwoven hexagonal metal wire mesh of 2-inch (50 mm) size.
C. Edging: Steel.

2.04 SOURCE QUALITY CONTROL

A. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.
B. Submit minimum 10 oz (280 g) sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.
C. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION

A. Install edging at periphery of seeded areas in straight lines to consistent depth.

3.03 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.
B. Apply after smooth raking of topsoil and prior to installation of sod.
C. Apply fertilizer no more than 48 hours before laying sod.
D. Mix thoroughly into upper 2 inches (50 mm) of topsoil.
E. Lightly water to aid the dissipation of fertilizer.

3.04 LAYING SOD

A. Moisten prepared surface immediately prior to laying sod.
B. Lay sod immediately after delivery to site to prevent deterioration.
C. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches (300 mm) minimum. Do not stretch or overlap sod pieces.
D. Where new sod adjoins existing grass areas, align top surfaces.
E. Where sod is placed adjacent to hard surfaces, such as curbs, pavements, etc., place top elevation of sod 1/2 inch (13 mm) below top of hard surface.
F. On slopes 6 inches per foot (500 mm per m) and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet (600 mm) on center. Drive pegs flush with soil portion of sod.
G. Prior to placing sod, on slopes exceeding 8 inches per foot (666 mm per m) or where indicated, place wire mesh over topsoil. Securely anchor in place with wood pegs sunk firmly into the ground.
H. Water sodded areas immediately after installation. Saturate sod to 4 inches (100 mm) of soil.
I. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roll sodded areas with roller.

3.05 MAINTENANCE

A. Provide maintenance at no extra cost to Owner; Owner will pay for water.
B. Provide maintenance of sodded areas for three months from Date of Substantial Completion.
C. Maintain sodded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.
D. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches (65 mm). Do not cut more than 1/3 of grass blade at any one mowing.
E. Neatly trim edges and hand clip where necessary.
F. Immediately remove clippings after mowing and trimming.
G. Water to prevent grass and soil from drying out.
H. Roll surface to remove irregularities.
I. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
J. Immediately replace sod to areas that show deterioration or bare spots.
K. Protect sodded areas with warning signs during maintenance period.

DIVISION 32 92 00 – PLANTS

PART 1 GENERAL

Landscape planting offers a cost-effective means to enhance overall project appearance, provide privacy at outdoor learning areas and provide summer sun shading and winter wind breaks. All species shall be of hearty, durable variety, require minimum maintenance and designated to be native to the regain (do not use plants considered to be invasive). Do not use plants with thorns, thistles, or toxic foliage, flowers, or fruit. All landscaping designs shall meet and exceed the requirements of the Uniform Development Code of Shelby County. At renovation/addition projects, the Design shall require the Contractor to isolate and protect existing planting not involved in the new construction. The Shelby County Government Tree Ordinance shall be specifically considered, but shrubbery and ground cover requirements may be subject to appeals. Note that the Grounds staff is not available for the upkeep of landscaping therefore, native plant material that does not require maintenance is essential. Care should be taken to preserve existing trees as they are already established and require little maintenance. Wooded areas should be preserved as they can often reduce grass cutting. Steep banks should be developed with ground cover or other plant material that does not require grass cutting equipment. All new plant material should be specified with a 2-year warranty to include replacement of any dead plant material. All site work shall be scheduled to be completed prior to building occupancy. All trees shall be a minimum 2”-3” caliper or as county ordinance dictates.

IMPORTED FIRE ANT CONTROL: In order to limit importation of Fire Ants, MSCS prefers that local plants be used. However, whether local or imported from outside the area, plants shall be accompanied by a certificate stating, "certified under all applicable state and federal quarantines." In addition, the specifications shall require that each shipment of plant materials shall be certified to be free of the presence of imported fire ants.

Where slopes exceed 1 in 3, it is recommended that ground cover such as Parson or Blue Pacific Juniper be planted and mulched with a minimum of 3" of pine straw. Another option is to plant a native grass i.e.: (reclaim native grass mixture per Lofts Seed, Inc. or a mixture as follows:

Rumsey Indian Grass	39%
Little Bluestem	27%
Gramma Grass	17%
Virginia Wild rye	14%
Switchgrass	3%

Planted at a rate of 30 lbs. per acre.

NOTE: Shrubs and plant material requiring trimming shall not be specified unless required by zoning codes. Coordinate with requirements of Shelby County Zoning Code on tree planting and buffer yard requirements.

1.01 SECTION INCLUDES

A. Preparation of subsoil.
B. Topsoil bedding.
C. New trees, plants, and ground cover.
D. Mulch and Fertilizer.
E. Maintenance.
F. Tree Pruning.

1.02 RELATED REQUIREMENTS

A. *Division 31 20 00* - Grading: Topsoil material.
B. *Division 31 00 00* - Fill: Topsoil material.
C. *Division 32 84 00* - Underground Sprinklers
D. *Division 32 92 00* - Sodding

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:
   1. See *Division 01 22 00* - Unit Prices, for additional unit price requirements.
   2. Topsoil: By the cubic yard (meter). Includes topsoil, placing topsoil.
   3. Plants: By the unit. Includes preparation of subsoil, placing topsoil, planting, watering and maintenance to specified time period.

1.04 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

B. Weeds: Any plant life not specified or scheduled.

C. Plants: Living trees, plants, and ground cover specified in this Section , and described in ANSI Z60.1.

1.05 REFERENCE STANDARDS

A. ANSI/AHIA Z60.1 - American National Standard for Nursery Stock; 2014.

B. ANSI A300 Part 1 - American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices (Pruning); 2017.

1.06 SUBMITTALS

A. See *Division 01 30 00* - Administrative Requirements, for submittal procedures.

B. Certificate: Certify fertilizer and herbicide mixture approval by authority having jurisdiction.

C. Maintenance Data: Include cutting and trimming method; types, application frequency, and recommended coverage of fertilizer.

D. Submit list of plant life sources.

E. Maintenance Contract.

F. Submit the following items:

1. Two (2) color photographs representative of each tree species, taken from two different vantage points, for approval by the Owner's Representative.

G. Submit the following materials certification:

1. Sod.
2. Peat moss.
3. Plant fertilizer.

1.07 QUALITY ASSURANCE

A. Nursery Qualifications: Company specializing in growing and cultivating the plants with three years' documented experience.

B. Installer Qualifications: Company specializing in installing and planting the plants with 5 years' experience with project of a similar scale.

C. Tree Pruner Qualifications: Company specializing in pruning trees with proof of Arborist Certification.

D. Tree Pruning: Comply with ANSI A300 Part 1.

E. Maintenance Services: Performed by installer.

F. Plant names indicated comply with HORTUS III, current edition, by the American Joint Committee of Horticultural Nomenclature. Names of varieties not listed conform generally with names accepted by the nursery trade. Provide stock true to botanical name and legibly tagged.

G. Comply with sizing and grading standards of the latest edition of American Standard for Nursery Stock. A plant shall be dimensioned as it stands in its natural position.

H. All plants shall be nursery grown under climatic conditions similar to those in the locality of the project for a minimum of 2 years.

I. Stock furnished shall be at least the minimum size indicated. Larger stock is acceptable, if approved by the Owner's Representative, at no additional cost, and providing that the larger plants are adequately proportioned.

J. Provide "specimen" quality plants, as indicated, with a special and superior shape and character of growth. Tag specimen trees or shrubs at the source of supply. The Owner's Representative may elect to inspect specimen selections at the source of supply for suitability and adaptability to selected location. When specimen plants cannot be purchased locally, provide sufficient color photographs of the proposed specimen plants for approval.

K. Plants may be inspected and approved at the place of growth, for compliance with specification requirements for quality, size, and variety.

L. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver fertilizers in waterproof bags showing weight, chemical analysis, and name of

manufacturer.

B. Protect and maintain plant life until planted.
C. Deliver plant life materials immediately prior to placement. Keep plants moist.
D. Deliver fertilizer materials in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. Store in manner to prevent wetting and deterioration.
E. Take all precautions customary in good trade practice in preparing plants for moving. Workmanship that fails to meet the highest standards will be rejected. Spray deciduous plants in foliage with an approved "Anti-Desiccant" immediately after digging to prevent dehydration. Dig, pack, transport, and handle plants with care to ensure protection against injury.
Inspection certificates required by law shall accompany each shipment invoice or order to stock and on arrival, the certificate shall be filed with the Architect/Engineer. Protect all plants from drying out. If plants cannot be watered immediately upon delivery, heel-in the roots by covering them with soil or wet peat moss, in a manner acceptable to the Owner's Representative. Water heeled-in plants daily. No plant shall be bound with rope or wire in a manner that could damage or break the branches.
F. Cover plants transported on open vehicles with a protective covering to prevent wind burn.
G. Provide dry, loose topsoil for planting bed mixes. Frozen or muddy topsoil is not acceptable.

1.09 FIELD CONDITIONS

A. Do not install plant life when ambient temperatures may drop below 35 degrees F (2 degrees C) or rise above 90 degrees F (32 degrees C).
B. Do not install plant life when wind velocity exceeds 30 mph (48 k/hr).
C. Work Notification: Notify Owner's Representative and irrigation contractor at least 3 working days prior to installation of plant material.
D. Protect existing utilities, paving and other facilities from damage caused by landscaping operations. All repair work shall be at Contractor's expense.
E. A complete list of plants, including a schedule of sizes, quantities, and other requirements shall be shown on the drawings. In the event that quantity discrepancies or material omissions occur in the plant materials list, the planting plans shall govern.

1.10 WARRANTY

A. See *Division 01 79 00* - Closeout Submittals, for additional warranty requirements.
B. Provide a one-year warranty. Warrant plant material in writing to remain alive and be in a healthy, vigorous condition for a period of 1 year after Substantial Completion and acceptance of entire project.
C. Warranty: Include coverage for one continuous growing season; replace dead or unhealthy plants.
D. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement. The cost of such replacement(s) is at Contractor's expense.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.
B. Provide certificate of compliance from authority having jurisdiction indicating approval of plants, fertilizer and herbicide mixture.
C. Plant Materials: Certified by federal department of agriculture; free of disease or hazardous insects.

2.02 PLANTS

A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.

2.03 SOIL MATERIALS

A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; minimum pH value of 6.0 and maximum 6.8.
    1. Provide topsoil free of substances harmful to the plants which will be grown in the soil.

2.04 SOIL AMENDMENT MATERIALS

A. Fertilizer: Type "A" Containing fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated in analysis.
   1. Nitrogen: 13 percent.
   2. Phosphoric Acid: 13 percent.
   3. Soluble Potash: 13 percent.
   4. 1/4 of nitrogen in the form of nitrates, 1/4 in the form of ammonia salt, and 1/2 in the form of organic nitrogen.

B. Peat Moss: Shredded, loose, sphagnum moss; free of lumps, roots, inorganic material or acidic materials; minimum of 85 percent organic material measured by oven dry weight, pH range of 4 to 5; moisture content of 30 percent, with less than 9% mineral content.

C. Bone Meal: Raw, finely ground, commercial grade, minimum of 3 percent nitrogen and 20 percent phosphorous.

D. Lime: Ground limestone, dolomite type, minimum 95 percent carbonates.

E. Water: Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants.

F. Anti-Desiccant: Protective film emulsion providing a protective film over plant surfaces; permeable to permit transpiration. Mixed and applied in accordance with manufacturer's instructions.

2.05 MULCH MATERIALS

A. Mulching Material: 6-month-old well-rotted ground bark, less than 4" length x 1/2" width, free of growth or germination inhibiting ingredients.

2.06 ACCESSORIES

A. Wrapping Materials: Burlap.

B. Stakes: 2"x2" hardwood.

C. Cable, Wire, Eye Bolts and Turnbuckles: Non-corrosive, of sufficient strength to withstand wind pressure and resulting movement of plant life. ArborTie brand or approved equal nylon ribbon manufactured for tree staking.

D. Plant Protectors: Rubber sleeves over cable to protect plant stems, trunks, and branches. Guying material shall be attached to tree with an arbor knot which expands to allow for girdle free growth.

E. Membrane: 20 mil (0.5 mm) thick, clear polyethylene.

F. Wrapping: Waterproof fabric.

2.07 TOP SOIL MIX

A. A uniform mixture of 1 part peat and 3 parts topsoil by volume.

2.08 SOURCE QUALITY CONTROL

A. Provide analysis of topsoil; comply with requirements of Section 01 4000.

B. Provide testing of imported topsoil.

C. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt and organic matter.

D. Submit minimum 10 oz (280 g) sample of topsoil proposed. Forward sample to testing laboratory in sealed containers to prevent contamination.

E. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

F. Plants: Provide plants typical of their species or variety; with normal, densely-developed branches and vigorous, fibrous root systems. Provide only sound, healthy, vigorous plants free from defects, disfiguring knots, sunscald injuries, frost cracks, abrasions of the bark, plant diseases, insect eggs, borers, and all forms of infestation. All plants shall have a fully developed form without voids and open spaces. Plants held in storage will be rejected if they show signs of growth during storage.
   1. Dig balled and burlapped plants with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Provide ball sizes complying with the latest edition of the American Standard for Nursery Stock. Cracked or mushroomed balls are not acceptable.
   2. Container-grown stock: Grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm and whole.

a. No plants shall be loose in the container.
b. Container stock shall not be pot bound.

3. Provide tree species that mature at heights over 25'-0" with a single main trunk unless otherwise indicated on Drawings. Trees that have the main trunk forming a "Y" are not acceptable, unless otherwise indicated on Drawings.
4. Plants planted in rows shall be matched in form.
5. Plants larger than those specified in the plant list may be used only when acceptable to the Owner's Representative.
   a. If the use of larger plants is acceptable, increase the size of the root ball or container in proportion to the size of the plant.
6. The caliper of trees shall be measured 6" above grade for trees less than 6" caliper, and 12" above grade for trees of 6" caliper and larger.
7. The height of the trees, measured from the crown of the roots to the top of the top branch, shall not be less than the minimum size designated in the plant list.
8. No pruning wounds shall be present with diameter of more than 1" and such wounds must show vigorous bark on all edges.
9. Evergreen trees shall be branched to the ground, unless otherwise indicated.
10. Shrubs and small plants shall meet the requirements for spread and height indicated in the plant list.
    a. The measurements for height shall be taken from the ground level to the average height of the top of the plant and not the highest branch.
    b. Single-stemmed, thin, or "leggy" plants will not be accepted.
    c. Side branches shall be generous, well-twigged, and the plant as a whole well-bushed to the ground.
    d. Plants shall be in a vigorous condition, free from dead wood, bruises, other root or branch injuries, or excessive drying.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared subsoil and planters are ready to receive work.
B. Saturate soil with water to test drainage.
C. Verify that required underground utilities are available, in proper location, and ready for use.
D. Examine proposed planting areas and conditions of installation. Do not start planting work until satisfactory conditions are corrected.

3.02 PREPARATION OF SUBSOIL

A. Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.
C. Scarify subsoil to a depth of 3 inches (75 mm) where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.
D. Dig pits and beds 6 inches (150 mm) larger than plant root system.
E. Time of Planting:
   1. Evergreen trees: Plant evergreen trees between September 1 and spring, before new growth begins.
   2. Deciduous trees: Plant deciduous trees in a dormant condition or as approved by Owner’s Representative.
   3. Evergreen and deciduous shrubs and ground covers: Planting is encouraged in the dormant season, although planting at other times may be acceptable, if approved in advance by the Owner's Representative.
   4. Planting times other than those indicated must be approved in advance by the Owner's Representative. If deciduous or evergreen trees are planted in-leaf, they shall be sprayed with an anti-desiccant prior to delivery and planting.
F. Planting shall be performed only by experienced workers familiar with planting procedures under the supervision of a qualified supervisor.
G. Locate all plants as approved in the field by Owner's Representative after staking by the Contractor. If obstructions are encountered that are not shown on the drawings, do not proceed

with planting operations until alternate plant locations are selected and approved.

H. Excavate circular tree pits with vertical sides at least 24" greater than diameter of root system. Depth of pit shall accommodate the root system. Scarify the bottom of pit to a depth of 4". Reuse excavated soil in planting soil mix.

I. All shrub and ground cover plants shall be installed in prepared, continuous planting beds using specified planting mixture. Bed dimensions shall be at least 6" wider and 6" deeper than root system.
   1. Modify bed preparation work in the vicinity of existing tree roots to preserve and protect the root system. In such instances, clarify requirements with Owner's Representative prior to actual work. Hand digging may be required.

J. If excessive moisture, or evidence of poor drainage is encountered in tree pits or planting beds, Contractor shall notify Owner's Representative before proceeding with work.

K. Provide pre-mixed planting mixture for use around the balls and roots of plants and in planting beds consisting of 5 parts local, approved soil, 1 part peat moss, and 1/2 lb. plant fertilizer Type "A" for each cubic yard of mixture.

3.03 PLACING TOPSOIL

A. Spread topsoil to a minimum depth of 4 inches (100 mm) over area to be planted. Rake smooth.
B. Place topsoil during dry weather and on dry unfrozen subgrade.
C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.
E. Install topsoil into pits and beds intended for plant root balls, to a minimum thickness of 6 inches (150 mm).

3.04 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.
B. Apply after initial raking of topsoil.
C. Mix thoroughly into upper 2 inches (50 mm) of topsoil.
D. Lightly water to aid the dissipation of fertilizer.

3.05 PLANTING

A. Place plants for best appearance.
B. Place plants for best appearance for review and final orientation by Architect/Engineer.
C. Set plants vertically.
D. Remove non-biodegradable root containers.
E. Set plants in pits or beds, partly filled with prepared plant mix, at a minimum depth of 6 inches (of 150 mm) under each plant. Remove burlap, ropes, and wires, from the root ball.
F. Set plant material in the planting pit to proper grade and alignment. Set plants upright, plumb, and faced to give the best appearance in relationship to each other or adjacent structures. Set plant material **2" above** the finish grade. No filling will be permitted around trunks or stems. Backfill the pit with planting mixture. Do not use frozen or muddy mixture for backfilling. Form a 4" high Saucer (compacted ring of soil) around the edge of each planting pit to retain water.
G. After balled and burlapped plants are set, muddle planting soil mixture around bases of balls and fill all voids. Tamp and add additional planting soil mixture.
   1. Remove all burlap, ropes, and wires from the tops of balls.
H. Mulching:
   1. Mulch around trees and continuously along shrub planting beds with required mulch, 2" deep, immediately after planting. Thoroughly water mulched areas. After watering, rake mulch to provide a uniform finished surface. Do not pile mulch around base of trunk.
I. Guying and staking:
   1. Inspect trees for injury to trunks, evidence of insect infestation, and improper pruning. Contact Owner's Representative if any of these problems exist.
   2. Staking:
      a. Stake all trees immediately after tree planting. Stakes to be wood stakes to be angled as shown in the planting details and of consistent height.
   3. All work shall be acceptable to the Owner's Representative.
J. Pruning:
   1. Prune evergreen and deciduous stock only to remove broken, damaged, or unsymmetrical branches, under direction of Owner's Representative.

2. Trees in areas of pedestrian activity shall be limbed up as required to prevent any hazards or obstruction to traffic. Branches shall be cut very close to main trunk, with no damage to bark. Branches shall be cut cleanly at a vertical angle slanting away from the main trunk.
3. Multiple leader plants: Preserve the leader which will best promote the symmetry of the plant. Cut branches flush with the trunk or main branch, at a point beyond a lateral shoot or bud, to a distance of not less than 1/2 diameter of the supporting branch. Make cut on an angle.

K. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6-inch (150 mm) layers. Maintain plant life in vertical position.
L. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

3.06 PLANT SUPPORT

A. Brace plants vertically with plant protector wrapped guy wires and stakes to the following:
1. Tree Caliper: 1 inch (25 mm); Tree Support Method: 1 stake with one tie
2. Tree Caliper: 1 to 2 inches (25 to 50 mm); Tree Support Method: 2 stakes with two ties
3. Tree Caliper: 2 to 4 inches (50 to 100 mm); Tree Support Method: 3 guy wires with eye bolts and turn buckles
4. Tree Caliper: Over 4 inches (100 mm); Tree Support Method: 4 guy wires with eye bolts and turn buckles

3.07 TREE PRUNING

A. Prune trees as recommended in ANSI A300 Part 1.
B. Prune newly planted trees as required to remove dead, broken, and split branches.

3.08 FIELD QUALITY CONTROL

A. Planted areas will be inspected at time of Substantial Completion and accepted subject to compliance with specified materials and installation requirements. Upon Initial Acceptance, the maintenance and one year warranty period will begin.
B. Perform field inspection and testing in accordance with Section 01 4000.
C. Plants will be rejected if a ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

3.09 MAINTENANCE

A. Provide maintenance at no extra cost to Owner; Owner will pay for water.
B. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
C. Maintain plant life immediately after placement and until plants are well established and exhibit a vigorous growing condition. Continue maintenance until termination of warranty period.
D. Irrigate sufficiently to saturate root system and prevent soil from drying out.
E. Cultivate and weed plant beds and tree pits.
F. Remove dead or broken branches and treat pruned areas or other wounds.
G. Neatly trim plants where necessary.
H. Immediately remove clippings after trimming.
I. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.
J. Control insect damage and disease. Apply pesticides in accordance with manufacturer’s instructions.
K. Remedy damage from use of herbicides and pesticides.
L. Replace mulch when deteriorated.
M. Maintain wrappings, guys, turnbuckles, and stakes. Adjust turnbuckles to keep guy wires tight. Repair or replace accessories when required.

3.10 CLEANING

A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, soil, debris, and equipment. Repair damage resulting from planting operations.

3.11 FINAL ACCEPTANCE/END OF WARRANTY PERIOD

A. Inspection to determine Final Acceptance of planted areas will be made by the Architect/Engineer (or Owner), upon Contractor's request. This will occur one year after Initial Acceptance. Provide notification for at least 10 working days before requested inspection date.
B. At the end of the Contractor's maintenance period, the Owner will assume plant maintenance.
C. Upon Final Acceptance, the Contractor shall remove all tree stakes, staking wire, and hose.

DIVISION 33 05 13 – DRAINAGE MANHOLES AND STRUCTURES

PART 1 - GENERAL

CLEANOUTS: A concrete pad shall be set flush with top of surrounding paving or finish grade around all cleanouts; size of pad to be 24" x 24" x 4" thick. Cleanouts shall be set flush with pad and installed within 10' of building wall or downspout location at all underground storm drainage lines.

A magnetic locator tape shall be installed at all underground non-metallic pipe installations. This tape shall be buried at a depth of 12" below top surface of earth and 12" below top of sub-grade at pavements and walks.

1.01 SUMMARY

A. This work shall consist of the construction of manholes, inlets, junction boxes, headwalls, wingwalls, skirts, brick radius, poured-in-place radius and other special drainage structures of the kinds and dimensions shown on the Plans, or stipulated in the Contract Documents. The construction shall be accomplished in accordance with these Specifications and in conformity with the lines, grades, cross-sections, and details shown on the Plans. The work shall include such labor, material, equipment, removal and abandonment of structures, brick masonry, cast-in-place concrete construction, precast concrete construction, rims and covers, frames and grates, miscellaneous iron castings, and all other items as may be necessary to complete the structures as shown on the Plans.

1.02 ACTION SUBMITTALS

A. Product information, materials and shop drawings for each type of pipe proposed for the Work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. New Material. All materials shall be subject to sampling, testing, and approval or rejection by the Owner. Unless otherwise specified, all materials incorporated into the work shall be new and unused in previous construction. Used materials, acceptable to the Owner, may be used for bracing, forms, falsework, and similar uses.

B. Manufacturer's Qualifications. The source of supply for each material to be supplied by the Contractor shall be subject to approval by the Owner before delivery. Precast concrete manhole sections, steel reinforcement, and iron castings shall be the standard product of a manufacturer of established reputation in the industry and manufactured in a permanent plant adapted to meet the specified design requirements of the material being supplied.

C. Inspection and Testing.

1. Representative samples of materials intended for incorporation in the work shall be submitted for examination when so specified or requested by the Owner. All materials to be used in the work shall be sampled, inspected, and tested in accordance with current ASTM specifications, or other specified standard specifications. The Contractor shall furnish the Owner with three copies of
   a. certified reports from a reputable testing laboratory showing the results of the tests carried out on representative samples of materials delivered and to be used in the project. The performance or cost of all testing is incidental to the work and shall be done at no cost to the Owner.
2. The Contractor shall notify the Owner in advance of any deliveries of the materials and shall make whatever provisions are necessary, including the furnishing of such labor as may be required to aid the Owner in the examination, inspection and culling of the materials on the site prior to installation in the work.
3. All materials not conforming to the requirements of these Specifications shall be considered as defective and rejected for use and shall be removed from the site of the work.

D. Storage. The Contractor shall provide such storage facilities and exercise such measures as will ensure the preservation of the specified quality and fitness of materials to be incorporated in the work.

E. Portland Cement Concrete. Portland cement concrete shall be of the class and dimensions, and at the designated locations shown on the Plans, or as directed by the Engineer. All portland cement, coarse aggregate, fine aggregate, water, air entraining agents and chemical admixtures; their proportioning, mixing, and delivery shall be as specified in Specification Section 321216.

F. Steel Reinforcement. Deformed steel reinforcing bar shall conform to ASTM A 615 for Grade 40

or Grade 60 and shall be of the grades, sizes, and dimensions and at the designated spacings and locations shown on the Plans or as directed by the Owner. Welded wire fabric conforming to ASTM A 185 shall have a minimum yield strength of 65,000 psi (448159.40 kPa) and fabric conforming to ASTM A 497 shall have a minimum yield strength of 70,000 psi (482633.20 kPa) and shall be of the size, design, and weight and at the locations shown on the Plans or as directed by the Owner. All steel reinforcement and its storage shall be as specified in Specification Division 03 20 00.

G. Mortar.
   1. Mortar shall be composed of the following mixture by volume: 1 part portland cement, 2 parts sand, hydrated lime not to exceed 10 percent of the cement used, and 4 parts water. All ingredients shall be proportioned by measurement and not by estimation. All portland cement, sand, and water shall be as specified in Specification Section 03050. All hydrated lime shall be as specified by ASTM C 6.
   2. The mortar shall be hand mixed or machine mixed. In the preparation of hand- mixed mortar, the sand, cement and hydrated lime shall be thoroughly mixed together in a clean, tight, mortar box until the mixture is of uniform color, after which water shall be added. Machine-mixed mortar shall be prepared in an approved mixer and shall be mixed not less than 1 ½ minutes. Mortar shall be used within 30 minutes after mixing.

H. Brick.
   1. All brick shall conform to the Specifications for Concrete Building Brick, ASTM C 55 for Grade A. Bricks shall conform to the following dimensions, unless otherwise approved by the Owner.

	DEPTH INCHES	**WIDTH INCHES**	**LENGTH INCHES**
STANDARD SIZE	**2 ¼**	**3 ¾**	**8 ½**
ALLOWABLE VARIATION	**+ ¼**	**+¼**	**+½**

   All brick shall be new and whole, of uniform standard size and with substantially straight and parallel edges and square corners. Bricks shall be tough and strong and free from injurious cracks and flaws. Brick shall be culled after delivery, if required, and all culls shall be removed from the work site.
   2. The Contractor may be required to furnish the Owner with at least five bricks of the character and make he proposes to use, at least one week before any bricks are delivered for use. All brick shall be of the same quality as the accepted samples.

I. Gray Iron Castings. Castings shall be of the standard Memphis type as detailed on the Plans and Design Standards. Castings shall be made of good quality, strong, tough, even-grained cast iron and shall be smooth, free from scale, lumps, blisters, sand holes, and defects of any nature which would render them unfit for the service for which they are intended. They shall be thoroughly cleaned and subjected to a careful hammer inspection. Castings shall meet the requirements of ASTM A 48, Specifications for Gray Iron Castings, Class No. 30, or ASTM A 536, Standard Specification for Ductile Iron Castings, Grade 65-45-12. In either case, manhole rims and covers and inlet frames and grates shall be designed to withstand HS 20-44 loading as defined by AASHTO Specifications. Before being shipped from the foundry, castings shall be given one coat of coal tar pitch varnish applied in a satisfactory manner so as to make a smooth coating, tough, tenacious and not brittle or with any tendency to scale off. Frames and covers shall be machined or ground at touching surfaces so as to seat firmly and prevent rocking. Any set not matching perfectly shall be removed and replaced at no additional cost to the Owner. The Contractor shall provide the Owner with invoices, bills of lading or other necessary documentation as proof of purchase of all castings. Documentation shall be submitted along with each request for payment.

J. Manhole Steps. Cast iron steps shall be of the standard Memphis type as detailed on the Plans and Design Standards. Cast iron shall conform to the requirements of Paragraph I above. Rubber or plastic coated steel manhole steps shall meet the requirements of ASTM C 478. The steel shall be completely encapsulated in corrosion resistant rubber or plastic. All steps shall be cast integral with manhole walls or grouted into manhole walls. Manhole steps can be driven in the manhole wall while concrete is still green and grouted around.

K. Structural Steel. Structural steel for sidewalk drains, inlets, and other structures shall be of the grades, thickness, shapes, and dimensions shown on the Plans and Design Standards or as directed by the Owner. Top plates for sidewalk drains shall be JAL- TREAD floor plate or equal. All surfaces of sidewalk drains shall be given one coat of coal tar varnish applied in a satisfactory manner as to make a smooth coating, tough, tenacious and not brittle or with any tendency to scale off.

L. Precast Concrete Manhole Sections.
   1. All precast reinforced concrete manhole risers, cones, grade rings, flat slabtops, and bases shall conform to the requirements of ASTM C 478 for the specified diameter and strength class. All cone sections and transition sections shall be eccentric in shape. Rings shall be custom-made with openings to meet indicated pipe alignment conditions and invert elevations. The Contractor shall submit shop drawings for each individual structure on the Plans for review by the Owner before placing his order for structures.
   2. The interior surfaces of the sections shall be a smooth, true cylindrical surface free from undulations or corrugations. Lifting holes when provided shall be cast in the wall of the pipe to receive a precast truncated conical concrete plug of such size as will allow 1/8 inch (3.18 mm) cementing material on the sides of the joining surfaces of the plug and will fill at least 50 percent of the lifting hole depth. Cement shall meet all requirements of the Specifications for Portland Cement, ASTM C 150, Type II.
   3. Joints between manhole sections shall be installed using rope type flexible plastic gasket material meeting the requirements for Type B gaskets or rope type flexible butyl gasket material meeting the requirements the requirements for Type A gaskets, as defined by AASHTO M-198 unless otherwise specified on the Plans or Design Standards. Joint contact surfaces shall be formed with machined castings; they shall be exactly parallel with a 2o slope and nominal 1/16 inch (1.59 mm) clearance. Joints between a manhole section and precast concrete flat tops shall be mortar joints conforming to the requirements of this Specification.

M. Sand. Sand for structure abandonment shall consist of sand, all of which passes a 3/8 sieve and not more than 10 percent passes a no. 200 sieve.

N. Crushed Limestone. Crushed limestone for precast manhole base bedding shall meet the requirements of Specification Section 334211.

O. Nonshrinking Grout. Grout shall be mixed in small quantities as needed and shall not be retempered or used after it has begun to set. Unless otherwise specified or directed, the grout shall consist of one part Portland cement and two parts sand by volume and a nonshrinking admixture mixed with sufficient water to form a grout of proper consistency. When nonshrinking or nonshrinking, fast setting grout is specified, it shall be formulated by the incorporation of an admixture or a premixed grout may be used. The formulation and the admixture of the premixed grout used will be subject to the review of the Owner and shall be mixed and used in accordance with the recommendations of the manufacturer. These special grouts will be classified as follows:
   1. Type I - Nonshrinking Grout
   2. Type II - Nonshrinking, Fast Setting Grout
   3. Portland cement, sand, and water shall conform to the requirements of Specification *Division 32 13 00*

PART 3 - EXECUTION

3.01 MODIFICATION OF EXISTING STRUCTURES

A. Removal. Existing structures to be removed shall be as indicated on the Plans or directed by the Owner. The Owner reserves the right to retain or reject salvage of any materials encountered. Unless otherwise directed by the Owner, all castings shall be retained by the Owner. All salvage materials retained by the Owner shall be delivered as directed by the Owner. All remaining materials become the property of the Contractor who will be responsible for disposing of same. The excavation shall be backfilled in accordance with Specification Section 312200. Removal of existing structures within the limits of excavation for new drainage facilities will not be measured or paid for separately but included in the price of the new drainage facility.

B. Abandonment.
   1. Existing structures to be abandoned in place shall be as shown on the Plans or as identified by the Owner.
   2. After removing structure frames, covers, grates, and similar items, all incoming and outgoing pipes shall be bulkheaded as specified in Specification Section 334211. The walls shall be lowered to 2 feet (60.96 cm) below final grade if in earth or to 12 inches (304.8 mm) below subgrade if in pavement. The remaining structure shall be filled with sand to the limits previously mentioned. The sand shall be placed in approximately 12-inch (304.8 mm) layers and each layer compacted to 95 percent of maximum density. A 12-inch-thick plain concrete slab shall be installed over the manhole or structure top that extends 12 inches beyond the outside face of the manhole of structure. The Owner reserves the right to retain or reject salvage of any materials encountered. All remaining materials become the property of the Contractor who will be responsible for disposing of same.

3.02 STORM DRAIN PIPE INSTALLATION

A. General.
   1. The structures will be either of concrete (plain or reinforced as required) or of brick masonry. Where the top elevation is not shown on the Plans, the structure or appurtenance shall be built to conform to the elevation ordered by the Owner.
   2. The various structures shall be built as the pipe laying progresses. The Owner, at this discretion, may stop the laying of pipe or the building of other structures until the structure just passed has been completed. Completion of the structure shall include connections to pipes, placing of castings and other construction as shown on the Plans or as directed by the Owner.
   3. Inlet and outlet pipes shall extend through the walls of structures only a sufficient distance beyond the outside surface to allow for connections and shall cut off flush with the inside surface of the wall as shown on the Plans or otherwise directed. The pipe shall intersect at the structures so that the invert between the inlet and outlet pipe can be smoothly formed such that counterflow is prevented.
   4. Inverts shall be of Class C concrete and shall conform to the shapes indicated on the Design Standards or otherwise directed. The inverts shall be so constructed
      a. as to cause the least possible resistance to flow. The shape of the inverts shall conform uniformly to inlet and outlet pipes. A smooth and uniform finish will be required.
   5. All rims and frames shall be placed in the positions shown in the Design Standards or as directed by the Owner and shall be set true to line and to correct elevation. Rims and frames shall be set concentric with the masonry and in a full be of mortar so that the space between the top of the masonry and the bottom flanges of the rim or frame shall be completely filled and made watertight. A ring of mortar at least 1 inch (25.4 mm) thick and pitched to shed water away from the rim or frame shall be placed around the outside of the bottom flange. Mortar shall extend to the outer edge of the masonry and shall be finished smooth and flush with the top of the flange. If rims or frames are to be bolted or anchored in concrete or brick masonry, all anchors or bolts shall be set and held in place before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has hardened to adequate strength.
   6. All manholes, inlets, and junction structures deeper than 4 feet (121.92 cm), as measured from the top of the rim or frame to the invert of the structure, shall be provided with steps unless otherwise shown on the Plans or directed by the Owner.
   7. Steps shall be spaced not more than 16 inches (406.4 mm) vertically and staggered at 12 inches (304.8 mm) laterally and shall be so arranged that the lowest step shall not be more than 18 inches (457.2 mm) above the bench. The top step shall not be more than 18 inches below the structure rim or frame. If precast sections are used, steps are not required to be staggered laterally.

B. Brick Masonry Construction.
   1. Construction Methods.
      a. All bricks shall be thoroughly clean. The bed which is to receive the bricks shall be thoroughly cleaned and damp, but should be free of water before placing mortar thereon. All bricks shall be laid in courses in freshly made mortar, using the shoved-

joint method so as to thoroughly bond them into the mortar and always with the joints completely filled with mortar. The bricks shall be laid in a workmanlike manner and true to the lines and grades indicated on the Plans and Design Standards. The arrangement of headers and stretchers shall be such as will thoroughly bond the masonry. Unless otherwise indicated, brick masonry for inlets shall have a header course every fifth course. In manholes, all bricks in each course shall be headers. The course shall be laid continuously with joints broken or alternating evenly with the joints in the preceding courses. Horizontal joints shall average 3/8 inch (9.52 mm) but shall be not less than ¼ inch nor more than ½ inch in thickness. Face joints shall be flush and neatly struck, and all joints on unexposed faces shall be solidly filled. No spalls or bats shall be used except in shaping around irregular openings or connections or when unavoidable to finish out a course. In this case, a full brick shall be used at the corner with the bat in the interior of the course. If any brick is moved or a joint broken during laying, the brick shall be removed, the mortar thoroughly cleaned from the brick, bed, and joints and the brick relaid in fresh mortar.

b. In brick manholes, inlets, or junction structures, a row lock arch shall beplaced over all incoming and outgoing pipes in such a manner to provide full continuous contact between masonry and outside of pipe, to prevent leakage and to form a neat connection.

c. Brick manholes, inlets, junction structures, brick radius wall, and special structures shall be plastered on the outside with a coating of mortar not less than ½ inch thick of the same composition used in laying brick to prevent excessive infiltration of water. On the inside of the manholes the vertical portion of the walls shall be plastered and the sloping section neatly pointed with trowel.

d. The inside of brick inlet, junction structure, or brick radius walls shall be plastered with not less than ½ inch of mortar of the same composition used in laying brick.

e. Brick masonry, plastering, and mortar shall be protected against damage from freezing or lack of moisture. Brick masonry shall not be constructed when the temperature is 40 degrees Fahrenheit (4.44 degrees Celsius) or lower without permission of the Owner nor without adequate approved means for protection against freezing. Brick masonry shall have sufficient moisture for proper curing and be protected from drying. Requirements for protection of brick masonry and masonry materials are the same as required for concrete structures in Specification *Division 32 12 00.*

f. A prepared concrete slab shall be placed for all brick structures after the foundation excavation is completed. This shall be of the materials and dimensions shown in the Design Standards. The slabs shall be built of Class A concrete. The construction shall conform to the methods, forms, placement, protection, and curing for concrete as specified in Specification *Division 32 12 00*.

g. Any required reinforcement shall be of the kind, type, and size and shall be located, spaced, bent, and fastened as shown in the Plans. Concrete reinforcing in place shall be approved by the Owner before any concrete is placed.

h. Steps constructed in brick walls shall be installed at the specified spacing as the brick laying progresses. Steps shall be placed in a full bed of mortar between brick courses.

2. Brick Manholes. Brick manholes shall be neatly and accurately built, according to Design Standards or as directed by the Owner. Manholes with brick walls shall have walls not less than 9 inches (228.6 mm) thick for manholes up to 6 feet (182.88 cm) deep and not less than 13 inches (330.2 mm) thick throughout the structure for extra depth manholes.

3. Brick Inlets.

a. Brick inlets shall be neatly and accurately built, according to Design Standard or as directed by the Owner. Inlets with brick walls shall have walls not less than 9 inches (228.6 mm) thick for inlets up to 6 feet (182.88 cm) deep and not less than 13 inches (330.2 mm) thick for inlets between 6 to 11 feet (335.28 cm) deep maximum throughout the structure for extra depth inlets.

b. Top slabs (when required) shall be uniform in thickness as shown on the Plans and be constructed of Class A concrete. Exposed surfaces shall have a troweled finish.

4. Brick Junction Structures. Brick junction structures shall be neatly and accurately built in accordance with details included in the Plans or as directed by the Owner. Access to all junction structures shall be provided by an access shaft with a manhole rim and cover at the proposed finished grade as detailed on the Plans.
5. Brick Radius.
    a. Brick radius shall be neatly and accurately built, according to the Plans and Design Standards, or as directed by the Owner. Brick radius walls shall not be less than 9 inches (228.6 mm) thick. The Contractor may at his option construct radius walls of reinforced concrete in lieu of brick.
    b. The radius of construction as shown on the Plans shall be as measured along the centerline of the structure and shall be constant throughout its length unless specified otherwise. The minimum radius shall be 5 times the inside diameter of the larger pipe at either end of the radius.
    c. The base slab and top slab of a brick radius shall be uniform in thickness as shown on the Plans and Design Standards and be constructed of Class A concrete reinforced as detailed. In lieu of cast-in-place top slabs, precast units may be used if approved by the Owner. These units shall be set securely on the brick walls using steel dowels, a mortar bed and mortared around dowels and between precast units. Care shall be exercised to set precast slabs with reinforcement on bottom side of panel when in final position.
    d. Pipe at both ends of the radius shall be laid in the final position and firmly bedded prior to commencement of brick radius construction. Longitudinal reinforcement shall extend from the normal radius section into a concrete pipe collar. The collar shall extend a minimum of 1 foot (30.48 cm) over each pipe end. Precast top slabs shall not be allowed over the pipe collars.
    e. Inverts shall be constructed of Class C concrete and form a smooth radius conforming with the larger of the two pipes which they adjoin.

C. Cast-In-Place Concrete Construction.
1. Construction Methods.
    a. All cast-in-place structures shall be built as shown on the Plans and of Class A concrete. The structures shall be built on prepared foundations and conform to the dimensions and shapes shown on the Plans. The construction shall conform to the methods, forms, placement, protection, and curing for concrete as specified in Specification *Division 32 13 00*.
    a. Any required reinforcement shall be of the kind, type, and size and shall be located, spaced, bent, and fastened as shown in the Plans and Design Standards. Concrete reinforcing in place shall be approved by the Owner before any concrete is placed.
    b. Connections for inlet and outlet pipes shall conform to the sizes, alignments, and elevations shown on the Plans.
    c. Steps, when required, shall be cast into the full depth of the wall section at spacings as previously specified. The Contractor may at his option construct steps after removing concrete forms. Under this option, holes shall be drilled of sufficient size to allow ½ inch to 3/4 inch (19.05 mm) of nonshrinking grout on all sides of the prongs and sufficient depth to allow full embedment of the prongs.
2. Cast-In-Place Manholes. Cast-in-place manholes shall be neatly and accurately built according to the Plans or as directed by the Owner. Wall thicknesses shall be as detailed on the Plans and Design Standards but not less than 6 inches (152.4 mm) thick. All cast-in-place manholes shall be of eccentric construction as shown on the Plans and Design Standards. The access steps shall be located on the vertical wall and staggered either side of a single vertical alignment in accordance with these specifications.
3. Cast-In-Place Inlets. Inlet walls may be built of concrete in lieu of brick at the Contractor's option. Concrete shall be Class A having a minimum wall thickness of 6 inches (152.4 mm). Cast-in-place inlets shall be constructed with the same inside dimensions as shown in the Plans and Design Standards.
4. Junction Structures. Junction structure walls may be built of concrete in lieu of brick at the Contractor's option. Concrete shall be Class A having a minimum wall thickness of 6 inches

(152.4 mm). Cast-in-place junction structures shall be constructed to the inside dimensions shown on the Plans and Design Standard or as directed by the Owner.

5. Cast-In-Place Radius. Concrete walls shall be Class A having a minimum wall thickness of 6 inches (152.4 mm). Cast-in-place radius shall be constructed to the radius and inside dimensions as shown in the Plans and Design Standards. Cast-in-place radius may also be constructed with a precast top slab set in a mortar bed and dowels if approved by the Owner.
6. Headwalls, Wingwalls, and Aprons. All headwalls, wingwalls, and aprons used with drainage pipe, box culverts, and concrete channel lining shall be constructed of Class A concrete and to the lines and dimensions shown on the Plans and Design Standards or as directed by the Owner.
7. Sidewalk Drains. Sidewalk drains shall be constructed to the dimensions and of the materials shown on the Plans and Design Standard or as directed by the Owner. Fillet welds shall be provided between the steel channels and steel plates as shown on the design Standard for Prefabricated Sidewalk Drain. Sidewalk drains shall be securely bedded on an earth subgrade at the same elevation and slope as adjacent sidewalk prior to pouring adjacent sidewalk. Concrete for sidewalk shall be placed uniformly on either side of the drain to prevent dislocation of the drain. Drains shall be held firmly in place by suitable means to prevent movement during placement of concrete. Sidewalk drains shall have positive drainage away from the drain. The drain shall be constructed through the curb and be terminated neatly and flush with the face of curb. Drains shall be placed with tread plate up and matching the sidewalk surface.

D. Precast Concrete Construction.
   1. Precast concrete manholes shall be neatly and accurately built according to the Plans or as directed by the Owner. All precast concrete manholes shall have a
      a. 10-inch (254 mm) concrete base slab constructed of Class “A” concrete, shall be cast integrally with the base section and the inlet and outlet pipes as shown on the Design Standard. Precast concrete base shall not be used.
   2. Precast concrete sections shall be set so the structure will be vertical and with sections in true alignment. Joint surfaces of the base or previously installed section shall have a flexible plastic gasket as described in these specifications installed in the recess after being primed with an asphaltic cement material recommended by the manufacturer. Each joint shall be completely filled with plastic gasket material on the inside and outside of the manhole after sections have been placed.
   3. All holes in precast sections used for their handling and the annular space between the wall and entering pipes shall be thoroughly plugged with nonshrinking grout, applied so that there will be no leakage through openings and around pipes. The grout shall be finished smooth and flush with the adjoining interior and exterior manhole wall surfaces.
   4. All precast concrete manhole cones shall be of eccentric construction as shown on the Plans. The access steps shall be located on the vertical wall and shall be aligned with the riser steps.
   5. All flat top slabs on drain manholes shall have a minimum thickness of 8 inches (203.2 mm) and the manhole rim and cover shall be located eccentrically in slab as shown on the Plans.

E. Test Specimens. The Contractor shall furnish the concrete necessary for casting test specimens in the field. The Owner will supply all molds and labor necessary to cast and test the specimens. The Owner will designate the frequency of sampling the fresh concrete. The method of making and curing test specimens will be in accordance with AASHTO Designation T
23. Test cores shall be drilled by the Contractor at this expense if required by the Owner at locations selected by the Owner.

DIVISION 33 14 00 – SITE WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Water-distribution piping and related components outside the building.

B. Related Requirements:
   1. *Division 0310 00* "Concrete Forming and Accessories."
   2. *Division 03 20 00* "Concrete Reinforcing."
   3. *Division 21 13 00* "Water-Based Fire-Suppression Systems."

1.02 DEFINITIONS

A. CDA: Copper Development Association.
B. EPDM: Ethylene-propylene-diene terpolymer rubber.
C. PA: Polyamide (nylon) plastic.
D. PE: Polyethylene plastic.
E. PP: Polypropylene plastic.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Submittals:
   1. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:
   1. Ensure that piping, valves, meters, backflow prevention devices, and fire hydrants are dry and internally protected against rust and corrosion.
   2. Protect threaded ends and flange faces against damage.
   3. Set piping, valves, meters, backflow prevention devices, and fire hydrants in best position for handling and to prevent rattling.

B. During Storage: Use precautions for piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:
   1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
   2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle products if size requires handling by crane or lift. Rig products to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.07 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service in accordance with requirements indicated:
   1. Notify Engineer no fewer than two days in advance of proposed interruption of service.
   2. Do not proceed with interruption of water-distribution service without Engineer's written permission.

1.08 COORDINATION

A. Coordinate connection to water main with Memphis Light Gas and Water (MLGW).

B. Content includes water-distribution piping and related components outside the building for combined domestic water service and fire-suppression water service. Terminate water-service piping with appropriate fitting for extension.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with MLGW requirements. Include tapping of water mains and backflow prevention.
B. Comply with standards of MLGW and City of Memphis for domestic water-service piping, including materials, installation, testing, and disinfection.
C. Comply with standards of MLGW and authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
D. Piping materials to bear label, stamp, or other markings of specified testing agency.
E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
F. Comply with FM Approvals' "Approval Guide" and/or UL's "Fire Protection Equipment Directory" for fire-suppression water-service products.
G. Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.
H. All piping and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372 or are certified in compliance with NSF 61/NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.02 PIPING MATERIALS

A. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and service sizes.
B. Potable-water piping and components comply with NSF 14, NSF 61, and NSF 372.

2.03 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:
    1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
    2. AWWA C104/A21.4 cement mortar-lined.
B. Mechanical-Joint, Ductile-Iron Fittings:
    1. AWWA C110, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
    2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
    3. AWWA C104/A21.4 cement mortar-lined.
C. Push-on-Joint, Ductile-Iron Pipe:
    1. AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
    2. AWWA C104/A21.4 cement mortar-lined.
D. Push-on-Joint, Ductile-Iron Fittings:
    1. AWWA C110, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
    2. Gaskets: AWWA C111/A21.11, rubber.
    3. AWWA C104/A21.4 cement mortar-lined.
E. Grooved-End, Ductile-Iron Pipe:
    1. AWWA C151/A21.51, with cut, rounded-grooved ends.
    2. AWWA C104/A21.4 cement mortar-lined.
F. Flanges: ASME 16.1, Class 125, cast iron.

2.04 PE PIPE AND FITTINGS

A. PE, ASTM Pipe: ASTM D2239, SIDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 200 psig (1378.95 kPa).
    1. Insert Fittings for PE Pipe: ASTM D2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
    2. Molded PE Fittings: ASTM D3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than 200 psig (1378.95 kPa).
    1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number
        a. matching pipe and PE compound number required to give pressure rating not less than 200 psig (1378.95 kPa).

2.05 PVC PIPE AND FITTINGS

A. PVC, Schedule 40 Pipe: ASTM D1785.
    1. PVC, Schedule 40 Socket Fittings: ASTM D2466.
B. PVC, Schedule 80 Pipe: ASTM D1785.
    1. PVC, Schedule 80 Socket Fittings: ASTM D2467.
    2. PVC, Schedule 80 Threaded Fittings: ASTM D2464.
C. PVC Pipe: AWWA C900, Class 165, with bell end with gasket, and with spigot end.
    1. Comply with UL 1285 for fire-suppression water service.
    2. PVC Fabricated Fittings: AWWA C900, Class 165, with bell-and-spigot or double- bell ends. Include elastomeric gasket in each bell.
    3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double- bell ends. Include elastomeric gasket in each bell.

2.06 PIPING JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.
B. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.
C. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.
D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.07 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
B. Flexible Connectors:
    1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
    2. Ferrous-Metal Piping: Stainless steel hose covered with stainless steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

2.08 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Valve Boxes: Provide valve boxes meeting MLGW standards and requirements. Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel as specified by MLGW.
    1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
B. Indicator Posts: UL 789, FM Global approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.09 DETECTOR CHECK VALVES

A. Source Limitations: Obtain detector check valves from single manufacturer.
B. Description: Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
    1. Standards: UL listed and FM Global approved.
    2. Pressure Rating: 175 psig (1206.58 kPa).
C. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

2.10 WATER METERS

A. Water Meter:
    1. Provide water meter meeting MLGW standards and requirements.

2.11 WATER METER BOXES

A. Water Meter Boxes:
    1. Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in

cover; and with slotted, open-bottom base section of length to fit over service piping.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.02 PIPING APPLICATIONS

A. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
B. Do not use flanges or unions for underground piping.
C. Underground water-service piping as shown in the drawings or as required by MLGW.
   1. PVC, C900, Class 165, ASTM D1784.
D. Water Meter Box Water-Service Piping: to be same as underground water-service piping.
E. Underground fire-service-main piping as shown in the drawings or as required by MLGW.
   1. Ductile-iron, Class 51, AWWA C151.
F. Underground Combined Water-Service and Fire-Service-Main Piping as shown in the drawings or as required by MLGW.
   1. Ductile-iron, Class 51, AWWA C151.

3.03 VALVE APPLICATIONS

A. General Application: Use valve types as shown in the drawings and required to meet MLGW standards and requirements.

3.04 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Provide continuous tracer wire if required by MLGW in sufficient length over each separate run of nonmetallic pipe.

3.05 INSTALLATION OF PIPING

A. Water-Main Connection:
   1. Arrange with MLGW for tap of size and in location indicated in water main.
   2. Tap water main in accordance with requirements of MLGW and of size and in location indicated.
B. Comply with NFPA 24 for fire-service-main piping materials and installation.
   1. Install PE corrosion-protection encasement in accordance with ASTM A674 or AWWA C105/A21.5.
   2. Install copper tube and fittings in accordance with CDA's "Copper Tube Handbook."
C. Install ductile-iron, water-service piping in accordance with AWWA C600 and AWWA M41.
   1. Install PE corrosion-protection encasement in accordance with ASTM A674 or AWWA C105/A21.5.
D. Install PE pipe in accordance with ASTM D2774 and ASTM F645.
E. Install PVC, AWWA pipe in accordance with ASTM F645 and AWWA M23.
F. Bury piping with depth of cover over top at least 36 inches (914.4 mm).
G. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
H. Extend water-service and fire-suppression water-service piping and connect to water- main and building systems to 5 feet (152.4 cm) from the outside face of building wall in locations and pipe sizes indicated.
   1. Terminate piping 5 feet (152.4 cm) from the outside face of building wall until building systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building systems when those systems are installed.
I. Install sleeve seals for piping penetrations of concrete walls and slabs as required. See building plans.
J. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.06 JOINT CONSTRUCTION

A. Make pipe joints according to the following:
   1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
   2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
   3. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end,

ductile-iron-piping couplings, gaskets, lubricant, and bolts in
a. accordance with coupling manufacturer's written instructions.

4. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners in accordance with fitting manufacturer's written instructions.
5. PVC Piping Gasketed Joints: Use joining materials in accordance with AWWA C900. Construct joints with elastomeric seals and lubricant in accordance with ASTM D2774 or ASTM D3139 and pipe manufacturer's written instructions.

3.07 INSTALLATION OF ANCHORAGE

A. Anchorage: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
   1. Concrete thrust blocks.
   2. Locking mechanical joints.
   3. Set-screw mechanical retainer glands.
   4. Bolted flanged joints.
   5. Heat-fused joints.
   6. Pipe clamps and tie rods.
B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
   1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: In accordance with AWWA C600.
   2. Gasketed-Joint, PVC Water-Service Piping: In accordance with AWWA M23.
   3. Fire-Service-Main Piping: In accordance with NFPA 24.
C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.08 INSTALLATION OF VALVES

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
C. UL-Listed or FM Global-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
D. UL-Listed or FM Global-Approved Valves Other Than Gate Valves: Comply with NFPA 24.
E. MSS Valves: Install as component of connected piping system.
F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves.
H. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.
I. Comply with requirements for concrete piers in Section 321216 for support of valves and piping not direct buried.

3.09 INSTALLATION OF WATER METERS

A. Install water meters, piping, and specialties in accordance with MLGW’s standards and requirements.

3.10 ROUGHING-IN FOR WATER METERS

A. Rough-in piping and specialties for water meter installation in accordance with MLGW’s standards and requirements.
B. INSTALLATION OF BACKFLOW PREVENTERS
C. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install in accordance with requirements of MLGW and authorities having jurisdiction.
D. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
E. Do not install bypass piping around backflow preventers.

3.11 INSTALLATION OF WATER METER BOXES

A. Install water meter boxes in accordance with MLGW’s standards and requirements.
   1. Install water meter boxes in paved areas flush with surface.
   2. Install water meter boxes in grass or earth areas with top 2 inches (50.8 mm) above surface.

3.12 INSTALLATION OF FIRE HYDRANTS

A. Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.
C. AWWA Fire Hydrants: Comply with AWWA M17.
D. UL/FM Global Fire Hydrants: Comply with NFPA 24.

3.13 INSTALLATION OF FIRE DEPARTMENT CONNECTIONS

A. Install ball drip valves at each check valve for fire department connection to mains.
B. Install protective pipe bollards as required by the AHJ at each fire department connection.

3.14 CONNECTIONS

A. Connect water-distribution piping to existing water main located in Steele St. Use connection that meet's MLGW's standards and requirements.
B. Connect water-distribution piping to interior domestic water and fire-suppression piping.

3.15 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
    1. Increase pressure in 50 psig (344.74 kPa) increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig (0.00 kPa). Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
C. Prepare reports of testing activities.

3.16 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."
B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel.

3.17 CLEANING

A. Clean and disinfect water-distribution piping as follows:
    1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
    2. Use purging and disinfecting procedure prescribed by authorities having
        a. jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
    3. Use purging and disinfecting procedure prescribed by MLGW or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
        a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
        b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
        c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
        d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
B. Prepare reports of purging and disinfecting activities.

DIVISION 33 30 00 – SEWAGE DISPOSAL

GENERAL

PUBLIC SEWER LINES: Provide maintenance hole to make tie-in to 6" and larger sewer. Provide at least 1 maintenance hole on site.

Use 4' diameter precast eccentric maintenance holes with steps 15" on center. Minimum cover in non-traffic areas is 3 ft. Minimum cover in traffic area - 5' for PVC, 3 feet for ductile iron on class 1 bedding.

DIVISION 33 31 00 – SANITARY SEWER GRAVITY PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. This work shall consist of the construction of sanitary sewers and service connections of the kinds and dimensions shown on the Plans, stipulated in the Contract Documents, or as directed by the Engineer. The construction will be accomplished by these Specifications and in conformity with the lines, grades, and details shown on the Plans or established by the Engineer. The Contractor will perform all work necessary to complete the Contract with the best modern practice. Without specifications that state the quality of any work, the Contractor is required to perform such items using first- quality construction. Unless otherwise provided, the Contractor will furnish all material, equipment, tools, labor, and incidentals necessary to complete the Work.

1.02 MATERIALS

A. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Unless otherwise specified all materials incorporated into the work shall be new and unused in previous construction. Used materials in acceptable condition may be used for trench bracing, forms, falsework, and similar uses. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

B. Higher strength pipe. The Contractor may substitute a higher strength pipe of the same type as that specified subject to the approval of the Engineer.

C. Manufacturer's qualifications. Pipe for sanitary sewers will be the standard product of an established, reputable manufacturer made in a permanent plant. Suppliers for each material to be used by the Contractor will be subject to approval by the Engineer. No material will be delivered until the manufacturer and product have been approved by the Engineer. For any construction project, pipe and appurtenances for each pipe material shall be the product of a single manufacturer having a minimum of 10 years' domestic experience producing the type of pipe supplied.

1.03 INSPECTION AND TESTING

A. Representative samples of material intended for incorporation in the work will be submitted for examination when so specified or requested. All material to be used in the work will be sampled, inspected, and tested by current ASTM specifications, or other standard specifications. The Contractor will furnish the Engineer with three copies of certified reports from an accredited testing laboratory showing the results of the tests carried out on representative samples of material to be used on the Project. Each length of pipe delivered to the project will show the laboratory's stamp. The performance or cost of all testing is the responsibility of the Contractor.

B. The Contractor will notify the Engineer before any deliveries of materials and will make whatever provisions are necessary to aid the Engineer in the inspection and culling of the material before installation.

1.04 STORAGE

A. The Contractor will provide and maintain storage facilities and exercise such measures to maintain the specified quality and fitness of material to be incorporated in the work. The interior and sealing surfaces of the pipe, fittings and adapters will be kept free from dirt and foreign matter. PVC pipe, fittings, and adapters stored outside and exposed to sunlight will be covered with an opaque material with proper ventilation.

1.05 ACTION SUBMITTALS

A. Pipe materials for each type of pipe proposed for the Work.

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) GRAVITY PIPE AND FITTINGS (8-15 INCH (381 MM) DIAMETER)

A. All PVC gravity pipe and fittings 8-15 inches (381 mm) in diameter shall be solid wall PVC; no profile wall PVC pipe is allowed for pipes 15 inches or less in diameter. PVC solid wall pipe and fittings for gravity sewer applications will conform to the requirements of ASTM D 3034. The standard dimension ratio (SDR) will be SDR 35 (Type PSM). PVC resin will conform to ASTM D 1784 cell class 12454C. A different cell class will be allowed only if the material meets the requirements of a superior cell class than 12454C. Fittings for PVC gravity sewer pipe will be fabricated from PVC meeting the respective ASTM PVC pipe standard for molded or extruded PVC. The wall thickness of the waterway and bell of fittings will be no less than the respective minimum thickness for the equivalent pipe. All fittings will be compatible with the pipe to which they are attached.

B. All PVC gravity pipe joints will be gasketed bell and spigot push-on type conforming to ASTM D 32J 2, unless directed otherwise in these Specifications. Gaskets will be part of a complete pipe section and purchased as such. Lubricant will be as recommended by the pipe manufacturer.

C. Solvent welded PVC saddle wye's may only be used on existing PVC and truss gravity sewer mains. Collar joints for fittings will be either Type SC (solvent cement) or Type OR (flexible gasketed compression joint) and will conform to the requirements of ASTM D 2680.

D. Portland Cement Concrete. Portland Cement Concrete will be of the class and dimensions shown on the Plans, or as directed by the Engineer. Portland cement, coarse aggregate, fine aggregate, water, air-entraining agents and chemical admixtures, their proportioning, mixing, delivery, minimum strength, sampling and testing will be as specified in Specification *Division 32 13 00.*

2.02 CRUSHED LIMESTONE

A. Crushed limestone will be size No. 67 Coarse Aggregate meeting the requirements of the Tennessee DOT Standard Specifications for Road and Bridge Construction and the following gradation:

Passing Each Sieve (US Std)					
Size	1”	3/4”	3/8”	No. 4	No. 9
No. 67	100	90-100	20-55	0-10	0-5

2.03 MORTAR

A. Mortar will be composed of one part Portland cement, two parts masonry sand, hydrated lime not to exceed 10 percent of the cement used, and 4 parts water. All ingredients will be proportioned by measurements and not by estimating. All portland cement, sand, and water will be as specified in Specification *Division 32 13 00*. All hydrated lime will be as specified by ASTM C 206.

B. The mortar will be hand mixed or machine mixed. In the preparation of hand mixed mortar the sand, cement and hydrated lime will be thoroughly mixed in a clean, tight, mortar box until the mixture is of uniform color, after which water will be added. Machine mixed mortar will be prepared in an approved mixer and will be mixed not less than 1 1/2, minutes. Mortar will be used within 30 minutes after mixing.

2.04 Bracing lumber. Lumber for tunnel bracing will be a minimum of 3 inches (76.2 mm) thick and made of bridge oak. All timbers will be of good quality, straight grained. And free from weakening knots and other defects. Bracing will be placed to form a structurally sound timber tunnel. The timber tunnel lining will remain in place after laying the pipe and backfilling.

2.05 BRICK

A. All brick shall conform to the Specifications for Concrete Building Brick, ASTM C 55 for Grade A. Bricks shall conform to the following dimensions, unless otherwise approved by the Owner.

	Depth Inches	Width Inches	Length Inches
Standard Size	2 ¼	3 ¾	8
Allowable Variation	+ ¼	+ ¼	+ ½

B. All brick shall be new and whole, of uniform standard size and with substantially straight and parallel edges and square corners. Bricks shall be tough and strong and free from injurious

cracks and flaws. Brick shall be culled after delivery, if required, and all culls shall be removed from the work site.

2.06 NON-SHRINKING GROUT

A. Grout will be mixed in small quantities as needed and will not be retempered or used after it has begun to set. Unless otherwise specified, the grout will consist of one part Portland cement, two parts masonry sand by volume, a nonshrinking, nonmetallic admixture and sufficient water to form a grout of proper consistency. When nonshrinking or nonshrinking fast setting grout is specified it will be formulated by the incorporation of an admixture, or a premixed grout may be used.

B. The formulation, admixture or the premixed grout used will be subject to the approval of the Engineer and will be mixed and used according to the recommendations of the manufacturer. These special grouts will be classified as follows:
   1. Type I - Nonshrinking Grout
   2. Type II - Nonshrinking, Fast Setting Grout

C. Portland cement, masonry sand, and water will conform to the requirements of Specification *Division 32 13 00*.

PART 3 - EXECUTION

3.01 LOCATION OF EXISTING OBSTRUCTIONS

A. Locations of obstructions shown on the Plans are approximate and are not intended as an accurate location of such obstructions. Obstructions not shown on the Plans but encountered by the Contractor will be removed and replaced in their original state or protected by the Contractor at no additional cost to the Owner.

3.02 REMOVAL OF OBSTRUCTIONS

A. The Contractor will demolish and remove all structures and structure foundations, abandoned vehicles, appliances, and rubbish within the right-of-way/easement limits necessary for the performance of the work.

3.03 PROTECTION OF OBSTRUCTIONS OUTSIDE EASEMENT LIMITS

A. The Contractor will protect and avoid damage to all trees, shrubs, plants, fences. structures, and all other objects outside the right-of-way/easement limits shown on the Plans and/or Plats due to construction operations. All damage will be repaired or restored at the Contractor's expense. Particular attention will be paid to avoid damage to trees, shrubs, bushes, and private property located next to rights-of-way/easements. No trees, plants, or other objects may be removed outside such limits without written permission of the property owner.

3.04 DISPOSAL OF DEBRIS

All trees, brush, logs, snags, leaves, sawdust, bark, and refuse will be collected and disposed of according to the City Code of Ordinances at the expense of the Contractor. There will be no separate pay item for disposal of debris. Debris will be removed from the site when practical and will not be left until the completion of the contract. When material is to be disposed of outside the easement, the Contractor will first obtain written permission from the property owner on whose property the disposal is to be made and will file a copy with the Engineer. Unless otherwise provided in the Contract Documents, the Contractor will arrange for disposing of such material outside the right- of-way/easement. No debris will be deposited in wetlands.

A. As approved by the Engineer, wood chips, mulch, etc. placed by the Contractor to prevent soil erosion are not considered debris. All erosion prevention materials will be placed and maintained in accordance with the project approved Stormwater Pollution Prevention Plan (SWPPP).

3.05 EXCAVATION

A. All excavation performed under this Section including trench excavation, structure excavation, and channel excavation, but excluding undercut excavation, will be considered unclassified excavation despite the nature of the material and objects excavated and will not be measured or paid for separately except as specifically noted.

B. Trench Excavation
   1. All trenches will be open cut unless otherwise shown on the Plans. Tunneling, boring, or jacking may be allowed by written permission of the Engineer,
   2. Trenches may be excavated by machinery to a depth that will not disturb the finished subgrade. The remaining material will be hand excavated so that the pipe is bedded on a firm, undisturbed subgrade.

3. No more than 300 feet (9144 cm) of trench will be opened ahead of the completed sanitary sewer. nor will more than 100 feet (3048 cm) be left unfilled except by written permission from the Engineer. In special cases the Engineer may limit the distance to which the trench may be opened by notifying the Contractor in writing.
4. The width of trenches below a level 1 foot (30.48 cm) above the outside top of pipe will be at least 6 inches (152.4 mm) but not more than 12 inches (304.8 mm) on each side of the outside of the pipe for all sizes up to and including 16 inches in diameter. A maximum trench width dimension for these pipe sizes will be 36 inches. For 18 inch (457.2 mm) diameter pipes, the width of trenches below a level 1 foot above the outside top of pipes will be at least 6 inches on each side of the pipe, with a maximum trench width of 42 inches (1066.8 mm). For pipe sizes more than 18 inches, the width of trenches below a level 1 foot above the outside top of the pipe will be at least 12 inches but no more than 15 inches (381 mm) on each side of the outside of the pipe. If the trench width at or below 1 foot above the top of pipe exceeds the width specified, provisions will be made at the Contractor's expense to compensate for the additional load upon the pipe.
5. The sides of the trench will be as nearly vertical as possible. The bottom of the trench will be carefully graded, formed, and aligned according to City of Memphis Standard SST-3 and to the satisfaction of the Engineer before sanitary sewers are laid.

C. Other Excavation
1. Undercut excavation will consist of removing and disposing of unsatisfactory material below the grade established on the Plans for sanitary sewers, structures, and manholes. No undercut excavation will be done without prior authorization of the Engineer. The limits of undercut escalation will be determined by the Engineer who will be present during the undercut operations.
2. Undercut areas will be backfilled with No. 67 limestone or other aggregate approved by the Engineer to the grade established on the Plans. The backfill will be placed in 6 inch (152.4 mm) maximum lifts and compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698) or a minimum relative density of 0.75. Undercut backfill will be encapsulated in geotextile fabric conforming to Specification Section 02370 2.01.C.
Unauthorized Excavation Below Subgrade or Outside Limits: Any unauthorized excavation and subsequent removal and backfilling beyond the lines and grades shown on the plans will be at the Contractor’s expense. The excess space between the undisturbed bottom and sides of the excavation and subgrade limits shown on the Plans will be backfilled according to these Specifications.

D. Change in Location and Grade
1. If the Engineer orders in writing that the location or grade of a proposed sanitary sewer facility be changed from that shown on the Plans, the following provisions will apply. If the change is made before excavation work has begun and the item being constructed is covered in the Proposal Sheet(s) by pay items with appropriate depth classifications, the appropriate pay item will apply. If the facility being constructed is not covered in the Proposal Sheet(s) and if the average excavation per linear foot at the changed location or grade is within 10 percent of the original Plan quantity, there will be no change in the unit price for this work. If the average excavation per linear foot at the changed location varies more than 10 percent above or below original Plan quantities, a Change Order will be prepared to cover the new work. For purposes of comparing changed quantities with Plan quantities, a 1 foot (30.48 cm) long strip will be calculated from natural ground line to invert along both the revised and original locations. These calculations will then be multiplied by the proper lengths to determine the total cost.
2. If the change is made after excavation has already begun on the original Plan location, the procedures described above will apply to payment for work along the changed location. If abandonment of an existing excavation is required due to a change by the Engineer, a Change Order will be prepared covering the backfilling and restoration of the abandoned excavation. Backfilling and restoration of the abandoned excavation will be accomplished according to the appropriate section of these Specifications.
3. Filling a portion of existing excavation to meet changed grades will be accomplished

according to these Specifications.

4. If a change in a location and/or grade is authorized in writing by the Engineer at the written request of the Contractor, the Contractor will not receive any additional compensation for the changed work. Backfilling and restoration of abandoned excavation work will be accomplished totally at the Contractor's expense.

E. Disposition of Excavated Material

1. Excavated material suitable for backfill will be stored no closer than 2 feet (60.96 cm) from the edge of the excavation, excavated material will not obstruct crosswalks, sidewalks, driveways, street intersections, nor interfere unreasonably with travel on streets. Gutters or other surface drainage facilities will not be obstructed. The Contractor must provide access to fire hydrants, mailboxes, sewer and conduit manholes and similar utility or municipal service facility as required. Excavated material intended for backfill will be stored in a way that minimizes loss of excavated material due to erosion. The Contractor shall comply with all applicable OSHA regulations and City of Memphis Storm Water Ordinances.
2. Unless otherwise directed, all excavated material that will not be used for backfilling or restoration will be removed from the site and disposed of by the Contractor. If the Contractor proposes to store or place such excess excavated material upon any private property, written consent of the property owner or owners must be obtained by the Contractor in advance. A certified copy wlll be given to the Engineer. No surplus or excess material will be deposited in any stream channel nor anywhere that would change preconstruction surface drainage.

F. Control of Water

The Contractor will keep all excavations free of water. If the trench subgrade consists of good soil in good condition at the time of excavation, it will be the Contractor's responsibility to maintain it in suitable condition. Dams, flumes, channels, sumps, or other work and equipment necessary to keep the excavation clear of water will be provided by the contractor. Dewatering of trenches will be incidental to trench excavation. The Contractor will avoid producing mud in the trench bottom by his operations. If necessary or so ordered by the Engineer, the Contractor will remove any soil that becomes unacceptable and replace it with limestone or other approved aggregate at his own expense to maintain a firm, dry base.

1. Pipe bedding, laying, jointing, and the placing of concrete or masonry will be done in a water free trench or excavation. Trenches will be kept clear of water until pipe joints, concrete and masonry have set and are resistant to water damage. The water will be disposed of in a manner acceptable to the Engineer.
2. All gutters, pipes, drains, conduits, culverts, catch basins, storm water inlets, ditches, creeks, and other storm water facilities will be kept in operation, or their flows will be satisfactorily diverted and provided for during construction. Any facilities disturbed during construction will be restored to the satisfaction of the Engineer.

G. Excavation Around Obstructions

1. The Contractor will perform all excavation by hand where excavation by machinery would endanger trees, structures, or utilities that otherwise might be saved by hand excavation.
2. The Contractor will cautiously excavate test holes to find the limits of underground obstructions anticipated within the excavation. When a water pipe, gas pipe, other sanitary sewer, storm drain, or similar utility comes within the limits of the trench, such facilities will be properly supported.

H. Excavation for Manholes and Special Structures

1. The Contractor will be responsible for performing the Work according to the lines and elevations shown on the Plans or as directed by the Engineer. The Contractor will excavate as required for all structures with foundations carried to firm, undisturbed earth at the elevation of the underside of the structure.
2. The outside dimensions of excavations for manholes and special structure will be at least 12 inches (304.8 mm) greater than the outside of the masonry or concrete work to permit backfilling around the structure.
3. Where structures are to be built in street rights-of-way or paved areas, the excavation will not exceed 2 feet (60.96 cm) from the outside of the masonry or concrete work. If the

excavation exceeds this limit, the Contractor will be required to backfill the entire space around the structure according to the drawings or project Specifications.

I. Special Protection
   1. Treacherous Ground: When running sand, quicksand, or other treacherous ground is encountered, the work will be carried on with the utmost urgency and will continue day, and night should the Engineer so direct.
   2. Sheeting and Shoring: The Contractor will furnish, place, and maintain sheeting and shoring as required to support the sides of any excavation to prevent earth movement that could endanger the workers or public and to prevent damage to the excavation, adjacent utilities or property. The Contractor will place the sheeting and shoring without the Engineer's instructions.
   3. Sheeting will extend below structure invert a sufficient depth to assure adequate support. In the installation of sheeting, the use of vibratory type pile drivers (as opposed to impact type) will be limited to sheeting driven no greater than 5 feet (152.4 cm) below the invert. The sheeted trench width, as measured between those faces of the sheeting in contact with the earth trench wall, will not exceed the maximum width of a trench per the plans and specifications. Walers and struts will be designed and installed to present no obstructions to proper placement of the pipe, bedding, cradle or encasement, and they will not interfere with the satisfactory installation of the pipe.
   4. Sheeting, bracing, and shoring will be withdrawn and removed as the backfilling is being done, except where the Engineer permits the material to be left in place. The Contractor will cut off sheeting left in place at least 2 feet (60.96 cm) below the surface and will remove the cut off material from the excavation.
   5. All sheeting, bracing, and shoring which is not left in place under this provision will be removed in a way that will not endanger the completed work or other structures, utilities, storm drains, sewers, or property. The Contractor will be careful to prevent the opening of voids during the extraction process.
   6. If sheeting and shoring are not specifically required on the Plans or in the Specifications, steel drag shields or trench boxes may be used subject to the authorization of the Engineer. Voids left by the advancement of the shield will be carefully backfilled and compacted following trench backfill requirements.
   7. Excess Width of Trench: If the Contractor is permitted to use equipment that results in wider trenches than specified, approved methods will be used around the pipe to resist the additional load caused by the extra width. The dimensions of the cradle or other methods will be specified by the Engineer. The contractor is responsible for meeting all applicable OSHA requirements. No extra compensation will be allowed for the additional material or work. Excess width trenches for semi-rigid and flexible pipe will be backfilled and compacted according to ASTM D 2321, and no concrete cradle will be used.
   8. Blasting: Blasting is not allowed.
   9. Underpinning: When excavations require underpinning of existing structures, the Contractor will submit shop drawings of underpinning details to the Engineer for review before commencement of excavation below the foundation of the structure. Review of underpinning details by the Engineer will not relieve the Contractor of his responsibility for protection of the structure and its contents.

J. Existing Utilities
   1. Location: The Plans show the readily available record of location of existing structures and facilities both above and below the ground, but the Owner assumes no responsibility for the accuracy or completeness of this information. Utility service connections are not shown on the Plans, but can be expected in built-up areas, and if relocating them is necessary, it will be the Contractor's responsibility to arrange for the relocation with the owner or owners of the utilities.
   2. Protection: The Contractor will protect any storm drain, sewer, or utility within the limits of the construction. The Contractor will proceed with caution and will use every means to establish the exact location of underground structures and facilities before excavating in the vicinity. The Owner will not be responsible for the cost of protection or repair or replacement of any structure, pipeline, conduit, service connection, or similar facility broken

or damaged by the Contractor's operations. All water and gas pipes and other conduits near or crossing the excavation will be properly supported and protected by the Contractor.

3. If the construction requires the removal and replacement of any overhead wires or poles, underground pipes, conduits, structures or other facilities, the Contractor will arrange for such work with the Owner or Owners of the facilities. No additional payment will be made by the Owner for this work.
4. Service Connections: Sewer and utility services between mains and buildings will be maintained and adjusted as necessary by the Contractor to provide as nearly a continuous operation as can be expected. This will be accomplished in any way that the Contractor chooses, provided the individual service is not interrupted for more than two consecutive hours. The occupants will be notified by the Contractor at least six hours before such service interruptions. When a break occurs, the Contractor will notify the affected occupant(s) of the probable length of time that the service will be interrupted.
5. If existing underground facilities or utilities require removal and replacement for the performance of this work, all replacements will be made with new material conforming to the requirements of these Specifications. If not specified, the material will be as approved by the Owner.
6. The removal and replacement of water services to adapt to new construction will be the Contractor's responsibility within the limits where the new service line grade blends smoothly with the existing service line grade.
7. The removal and replacement of sewer house connections to adapt to new construction will be the Contractor's responsibility from the sewer main to a point where the new grade and existing grade can be matched.
1. The Contractor will be responsible for any damage to the sewer house connection because of his operations. The Engineer does not guarantee the number, size, condition, nor length of adjustment necessary to bring a service to a new grade.

3.06 SEWER PIPE INSTALLATION

A. General
   1. Sewer pipe and bedding will be constructed as shown on the Plans. It will be the Contractor's responsibility to find all underground utilities before construction to ensure there are no conflicts with the proposed line and grade. The Contractor’s surveyor shall verify the base information on the plans prior to commencement of construction. Any discrepancies in the plans shall be reported to the Engineer immediately. If approved by the Engineer, minor changes in the alignment or grade will be permitted to avoid underground facilities, if straight alignment can be maintained between manholes. If minor changes in line or grade cannot avoid a conflict with the existing utility, the Contractor will arrange with the owner of said utility to have it adjusted as required to accommodate the proposed sewer at no additional expense to the Owner.

B. Modifications of Existing Sanitary Sewer Facilities
   1. Maintenance of Flow: Where existing sewer lines are being modified, the Contractor will arrange his work so that sewage flow will be maintained during the construction period with no discharge of sewage into the open trench and no back up of sewage in the existing line. The contractor will provide necessary bypass pumping capacity to carry flow downstream of the section to be modified.
   2. Abandonment of Sewer Pipe: Sewer pipe called for in the Specifications or Plans to be abandoned will be sealed at each end for a minimum distance of 18 inches (457.2 mm), or one-half the diameter of the pipe, whichever is greater. Unless otherwise specified, the pipe will be sealed with a brick bulkhead and/or acceptable cement grout to form a solid watertight plug completely bonded to the pipe. Any sewer manholes to be abandoned will be abandoned per the plans and Specifications.
   3. The Contractor will be allowed to remove pipe to be abandoned if wanted. If the Contractor elects the removal method, all associated costs will be included in the cost for other Pay items.
   4. Connection to Existing Manholes: The Contractor will core suitable openings into existing manholes or remove existing pipe to accommodate the sewer pipe at the proper elevation, location, and direction, as indicated on the Plans. Care will be used to avoid unnecessary

damage to the existing manhole.

5. All loose material will be removed from the cut surfaces that will be completely coated with nonshrinking grout before setting the pipe. Before inserting the pipe, a sufficient thickness of grout will be placed at the bottom and sides of the opening for proper bedding of the pipe. For semi-rigid and flexible pipe installations a water stop as approved by the pipe supplier will be installed on the pipe according to the manufacturer's recommendations. After setting, all spaces around the pipe will be solidly filled with nonshrinking grout and neatly pointed up on the inside to present a smooth joint, flush with the inner wall surface. Any necessary revisions on the existing manhole invert will be made to provide a smooth, plastered surface for properly channeled sewage flow from the new connection. Plaster on the exterior of brick manholes will be repaired with nonshrinking grout. Particular care wlll be given to ensure that the earth sub-base and bedding next to the manhole will provide firm solid support to the pipe.
6. Removal of Sewer Pipe: Existing pipes and manholes to be removed and their locations will be shown on the Plans. Existing sewer pipe and manholes that must be removed to excavate for the proposed sewer will be included in the cost of the proposed sewer pipe and no additional compensation will be made to the Contractor. The Owner reserves the right to retain or reject salvage of any material encountered. All remaining material becomes the property of the Contractor who will be responsible for properly disposing of the same.

3.07 PIPE BEDDING

A. Bedding will be defined as that material supporting. surrounding and extending to one foot above the top of the pipe. Bedding for sewer pipe will conform to the requirements given below for Class A, B.1, or B.2, whichever is shown on the Plans. If the class of bedding is not shown, a minimum of Class B.1 or B.2 bedding will be provided as specified below. At the direction of the engineer or as shown on the plans, sewer pipe and Class B.1 or B.2 bedding will be encapsulated in geotextile fabric.
   1. Class A - Concrete Cradle: Class A bedding for sewer pipe will consist of a continuous concrete cradle constructed in conformity with the details shown on the plans or as directed by the Engineer. Class A bedding will only be used for rigid pipe.
   2. Class B.1-Crushed Limestone: Class B.1 bedding will be number 67 crushed limestone. Pipe 4 inches (101.6 mm) to 24 inches in diameter will be bedded on 4 inches of bedding material. Pipe 27 inches (685.8 mm) to 48 inches (1219.2 mm) in diameter will be bedded on 6 inches (152.4 mm) of bedding material. Bedding for pipes larger than 48 inches in diameter will be by design based on anticipated soil conditions. After pipe installation, crushed limestone will then be tamped under the haunches continuing in layers not more than 6 inches in loose thickness around the pipe to the spring line. The remainder of the installation will be as outlined in the plans. Unless otherwise instructed, concrete and ductile iron pipe will be bedded in Class B.1 bedding.
   3. Class B.2-Crushed Limestone: Class B.2 bedding will be number 67 crushed limestone. Pipe 4 inches (101.6 mm) to 24 inches in diameter will be bedded on 4 inches of number 67 crushed limestone Pipe 27 inches (685.8 mm) to 48 inches (1219.2 mm) in diameter will be bedded on [6] inches ([152.4] mm) of bedding material. Bedding for pipes larger than [48] inches ([1219.2] mm) in diameter will be by design based on anticipated soil conditions. After pipe installation, crushed limestone will then be tamped under the haunches and continued in layers not more than 6 inches in loose thickness around and above the pipe to a level 6 inches above the outside top of the pipe. The remainder of the installation will be as outlined in the plans. Class B.2 bedding will be used for all flexible pipe including fiberglass reinforced polymer mortar pipe, PVC and HDPE.

3.08 PIPE LAYING

A. Inspection Before Laying
   1. All pipes will be inspected on delivery. Pipe that does not conform to the requirements of these Specifications or is not suitable for use will be rejected and immediately removed from the work site.

B. Preparation of Pipe Ends
   1. All surfaces of the pipe to be joined will be clean and dry. All necessary lubricants, primer,

adhesives, and similar material will be used as recommended by the pipe or joint manufacturer's specifications.

C. Care During Hoisting Placing And Pushing Home
   1. Equipment used to handle, lay, and join pipe will be equipped and used as to prevent damage to the pipe. All pipe and fittings will be carefully handled and lowered into the trench. Damaged pipe or jointing material will not be installed.

D. Direction of Work
   1. The laying of pipe will commence at the lowest point. The bell or grooved end will be laid upgrade. All pipes will be laid with ends abutting and true to line and grade. They will be carefully centered so that when laid they will form a sewer with a uniform invert.

E. Uniform Pipe Bearing

   Special care will be taken to ensure that the pipe is solidly and uniformly bedded, cradled, or encased according to the Plans. For pipe with a bell that is larger than the barrel of the pipe the bedding material will be removed to a depth that will provide continuous support for the bell and barrel. No pipe will be brought into position for joining until the preceding length has been bedded, joined, and secured in place. Where a concrete cradle is required, the pipe will be supported at no more than two places with masonry supports of minimum size sufficient to provide the required clearance and to prevent displacement during placing of concrete.

F. Alignment and Grade
   1. Each piece of pipe will be checked for vertical and horizontal alignment immediately after being laid. All adjustments to alignment and grade must be made by scraping away or filling in under the barrel of the pipe and not by wedging or blocking up any portion of the pipe or striking the pipe to drive it down. Curved alignments will not be allowed except as directed by the Engineer.

G. Backfilling to Secure Pipe
   1. When the joint is made, sufficient backfill material will be simultaneously placed along each side of the pipe to prevent moving the pipe off line and grade. Particular care will be used to prevent disturbance or damage to the pipe and the joints during backfilling.

H. Flotation and Water in the Trench
   1. The Contractor will take all necessary precautions to prevent flotation of the pipe in the trench. Water will not be allowed to rise in the trench. The Contractor will use well points, sump pumps, or another approved method of dewatering as required to lower the water table below the bottom of the excavation while minimizing the migration of fines from the surrounding area. The Contractor will make a request to the Engineer and receive approval prior to the use of special dewatering equipment other than well points or sump pumps. Dewatering operations are considered incidental to the work and no additional compensation will be made to the Contractor.

I. Open Ends
   1. Whenever pipe laying is stopped for any significant length of time, such as at the end of a workday, the unfinished end will be protected from damage and a temporary tight fitting plug or bulkhead will be placed in the exposed ends of the pipe to keep soil or other debris from entering the pipe.

J. Concrete Cradle Section next to Manhole
   1. The pipe will be supported from the manhole wall to the limits of the manhole excavation in a normal sewer trench with a concrete cradle, structurally continuous with the manhole base slab or footing. Cost for this work is incidental to the cost of the pipe installation.

K. Cutting Pipe
   1. Cutting will be in a neat workmanlike manner at right angles to the pipe axis without damage to the pipe. Observe specifications regarding joint locations. Smooth the cut end by power grinding or filing to remove burrs and sharp edges. Repair lining of the pipe as required.

L. Wyes and Special Fittings
   1. Wyes, stubs, seducers, fittings, or other special pipes will be installed as shown on the Plans or where ordered by the Engineer. The fittings and special pipes will be made of a compatible material, type, and class and/or strength designation as the pipe and installed

as required by the Plans and Specifications. The cost for providing and installing the above items is incidental to the cost of the pipes.

M. Valves
   1. Valves and appurtenant fittings will be installed as shown on the Plans or where directed by the Engineer.
   2. Check valves and gate valves will be installed on either flanged or mechanical joint ductile iron pipe.
   3. Air release, vacuum relief and combination air valves larger than 3 inches (76.2 mm) in diameter will be installed on either flanged or mechanical joint ductile iron pipe. A gate valve conforming to Specification Section 02530 2.01.Q shall be installed to isolate these air valves from the force main.
   1. Air release, vacuum relief and combination air valves 3 inches (76.2 mm) in diameter and smaller will be installed on a ductile iron tap 'T fitting. A ball valve conforming to the Specifications shall be installed on a 6" threaded nipple between the ‘T’ and the air valve.

3.09 PIPE JOINTS

A. General
   1. Pipe will be jointed immediately following the laying of each section. No pipe section will be left overnight which has not been completely jointed to the preceding pipe section in conformance with these Specifications.
   2. The following provisions will apply to insure tight and sound joints:
      a. The joint will be placed with special care to avoid breaking joints and to leave gasket, if required, in proper position.
      b. All pipe 12 inches (304.8 mm) in diameter or larger will have dead weight held by crane while being lined up and pushed home.
      c. Pipe will be pushed home with a constant and even force and not jarred home by the momentum of a moving force that will place an impact load on pipe.
      d. Cement and lubricant will be used as recommended by the manufacturer and designated by the Engineer.

B. Compression Joints
   1. The two ends to be joined will be thoroughly cleaned and a compression gasket compatible with the type of pipe to be joined will be at the position recommended by the pipe manufacturer.
   2. Lubricant recommended by the gasket manufacturer will be liberally applied to the gasket and both ends immediately before pipe ends are joined. The upstream pipe will be positioned such that the spigot may enter the bell squarely. The pipe being laid will be pushed home and the gasket position checked with a feeler gauge before installation of the next section. Flat, unconfined gaskets on concrete pipe will be cemented to the spigot at the position recommended by the pipe manufacturer.

C. Mechanical Joints
   1. The two ends to be joined will be thoroughly cleaned with a wire brush and the plain end, socket end, and gasket will be brushed with soapy water. The end will be centered in the socket and adequate anchorage will be provided to hold the pipe in position until the joint can be completed. When deflecting pipe from a straight line is necessary, the deflection will be made after joint assembly and before tightening bolts. Pipe deflection will not exceed that specified by ANSI C 600.
   2. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. All bolts will be torqued to the required range recommended by the pipe manufacturer. Over stressing of bolts will be avoided. Gauge lines on the spigot end will be checked following assembly to ensure proper positioning of bell and spigot has been accomplished.
   3. Any joints not properly positioned will be disassembled, cleaned. and reassembled as previously indicated.

D. Flanged Joints
   1. The two ends to be joined will be thoroughly cleaned with a wire brush. Bolt holes on each pipe flange to be joined will be aligned and bolts inserted. Bolts will be torqued evenly by

alternating tightening of bolts opposite one another until all bolts are torqued to the recommended pressure.

E. Solvent Cement Joints

The two ends to be joined will be thoroughly cleaned and primer liberally applied to the outside of the spigot within the joint insertion limits and inside the bell in conformance with the manufacturer's recommendations. Cement will be applied immediately to the same surfaces as the primer and the pipe joined within one minute. A sufficient quantity of cement will be applied to form a bead of excess cement around the full circumference of the joint when the spigot is fully inserted. The spigot end will be inserted to the insertion stop mark and rotated one-fourth turn. Avoid disturbing the joint until cement has had ample time to set.

F. Restrained Joints

1. Restrained push-on joints are to be used as specified on the plans or by the Engineer. These special joints will be installed as specified by the manufacturer. The length of the pipe to be restrained will be determined by the Engineer based on pipe size, internal pressure, depth of cover, and soil characteristics around the pipe.

3.10 PIPE CAPS AND PLUGS

A. Wyes, stubs, or other fittings installed in the pipe for future connections will be closed at the open end. For pipes 21 inches (533.4 mm) in diameter or smaller, an approved cap or plug will be installed in the bell or socket using the same type joint or jointing material as required for the sewer. For pipes larger than 21 inches in diameter, temporary approved masonry bulkheads of the thickness required by the Plans and Specifications to close the open end may be substituted for stoppers. Care in backfilling will be used so that such closure and its seal will not be disturbed. This stopper will be jointed so that it may be removed later without injury to the pipe itself. Work and material costs are incidental to the cost of the pipe installation.

3.11 SERVICE CONNECTIONS

A. All service connections on new pipe up to and including 12-inch (304.8 mm) diameter will be 6-inch (152.4 mm) diameter in-line wye connections unless indicated otherwise on the Plans. Service connections on pipes larger than 12 inches in diameter will not be allowed. Saddles will not be used on new construction.

B. All service connections on existing pipe up to and including 12-inch (304.8 mm) diameter will be 6-inch (152.4 mm) diameter. lnsert a Tee, or approved equal, or saddle wye connections.

C. Although the general location of connections may be shown on the drawings, the actual location will be determined by the Contractor, subject to approval by the Engineer. Connections for undeveloped property will generally be at the center of the lot. Connection locations for developed property will be coordinated with the property owner, The quantities shown on the proposal sheet are only approximate and are subject to change. The depth of connections at the property line will be determined by the Engineer. Service connections will be laid on no less than a 1 percent grade for 6-inch (152.4 mm) diameter connections unless otherwise directed by the Engineer. Each building connection will be accurately recorded by station offset and depth on the as-built drawings and will be furnished to the Engineer. Unless authorized by the Engineer in writing, or shown on the drawings, building connections will not be tied into new or existing manholes. When service connections are tied into manholes at an elevation greater than 2 feet (60.96 cm) above the manhole invert, the service will be constructed as a drop construction as specified in the Plans or Specifications.

D. Service connections will be laid in open trenches except where tunneling may be necessary under existing curbs, sidewalks, or pavements. In all such instances, a shaft must be excavated at the end of the connection for inspection purposes and measurement of length and depth. All service connections will extend to the right-of- way or easement limits. The service connection will be installed in conformance to the City of Memphis Standard No. SST-16.

3.12 PIPE ENCASEMENT, COLLARS, AND THRUST BLOCKS

A. General

1. Concrete will be Class "C" Concrete as specified in Specification Section 321313. All concrete will be placed, cured, and protected according to the applicable paragraphs of the Specifications. Pipe alignment will be inspected immediately following concrete placement and any misalignment caused by the placement of concrete will be corrected before the

initial set. Concrete will be protected against water until completely cured.

B. Pipe Encasement
   1. Concrete encasement for pipes is to be used at the locations shown on the Plans or as directed by the Engineer. Concrete will be Class C and will be reinforced as required. All pipe requiring encasement will be blocked at each joint using masonry supports of a minimum size sufficient to provide the required clearance and to prevent displacement during placing of concrete. Concrete will be placed on either side of the pipe in approximately equal amounts to prevent movement of the pipe. Concrete encasement is to be rectangular in section with a thickness of 1/2 the pipe diameter between the outside edge of pipe and the outside of encasement at the closest point unless shown otherwise on the Plans. The absolute minimum thickness for concrete encasement shall be 6 inches (152.4 mm) regardless of pipe size.

C. Pipe Collars
   1. Concrete pipe collars are to be used to join pipe ends that cannot be joined with prefabricated joints. Concrete will be Class C and will be reinforced when shown on the Plans. Concrete pipe collars will be constructed at the locations and to the dimensions shown on the Plans or as directed by the Engineer. Pipes being joined will be blocked and supported laterally to prevent movement during placing or curing of concrete. Rubber water stops will be placed on each pipe before pouring the concrete collar. Fernco or equal mechanical coupling will be used for pipe connectors 16 inches (406.4 mm) and smaller.

D. Thrust Blocks
   1. Concrete thrust blocks are to be used to resist internal thrust pressures at bends and fittings in force mains at the locations shown on the Plans or as directed by the Engineer. Concrete will be Class C and will be reinforced when shown on the Plans. Thrust blocks will conform to the dimensions shown on the Plans or City of Memphis Standard SST-12. Load distribution type thrust blocks will be poured continuously from the force main to the undisturbed trench face. Backfill will not be placed as backing material for load distribution type thrust blocks.
   2. All concrete will be poured in a way that leaves the pipe joint accessible for caulking or tightening of bolts. Care will be taken to permit the concrete to cure long enough to develop sufficient strength before the concrete is required to withstand the thrust. The area of the concrete bearing on the main or the restraining mass must be large enough to prevent over stressing the concrete.
   3. If a concrete mass is used, a form may be necessary to contain the mass to provide access to joints or to ensure the required bearing area. Generally, some form work is required for the mass of concrete necessary for blocking on mains sized 12 inches (304.8 mm) and larger. In poor soil, forming the concrete mass to construct the necessary bearing surface will be necessary. Instead of this construction, a restrained joint may be used.
   4. Thrust blocks will be included in the linear foot price for the force main.

3.13 BACKFILLING

A. General
   1. After sanitary sewer facilities have been bedded and installed according to these Specifications and upon permission of the Engineer, the backfill may be placed. Backfilling operations will continue following as closely behind pipe installation as practical. All backfills will be placed in uniform horizontal layers. Pushing backfill material down a ramp into excavated areas will not be permitted. No trash will be allowed to accumulate in the space to be backfilled. Particular care will be taken to avoid allowing wood to be included in the backfill, other than sheeting and shoring that has been approved to be left in place. The Contractor will be responsible for the condition of the trenches and filled areas during the contract and warranty period. The Contractor will maintain frequent inspection of the same. Anytime during the 12-month warranty period the trenches or filled areas settle and sunken places appear, the Contractor will be required to refill these sunken places when they are discovered with suitable material and will replace all damaged curb, gutter, and sidewalk. All soft or dangerous trenches will be marked, barricaded, and caution lighted for the protection of the public.

2. Property with an existing dwelling located on it or lots within a developed subdivision or planned development are considered improved property.

B. Street Right-of-Way and Improved Property
   1. Backfill Material:
      a. Backfill for manhole and pipe trench excavations through pavements in street or highway right-of-way or where the Engineer orders, will be made with pit run gravel or other acceptable material as approved by the Engineer. The backfill will be from the top of the bedding material or foundation to the subgrade elevation of the pavement. Pea gravel or similar granular material approximately uniform in size and without bonding properties will not be used.
   2. Backfill for manhole and pipe trench excavations beyond pavements in street or highway right-of-way or outside public right-of-way will be made with select earth from the top level of the bedding material or foundation to the subgrade elevation in paved area, or within 1 inch (25.4 mm) of the surface in areas to be sodded, or to the surface in all other areas.
   3. Select material will be free from debris, organic matter, perishable compressible material and will contain no stones or lumps larger than 6 inches (152.4 mm). Rocks and lumps smaller than 6 inches will not exceed an amount that will interfere with the consolidating properties of the fill material. Care will be taken that stones and lumps are kept separated and well distributed, and that all voids are completely filled with fine material. No rocks or lumps will come in direct contact with the pipe. The upper 3 feet (91.44 cm) of backfill in sodded or planted areas will be free of rocks or lumps larger than 1 inch (25.4 mm) in diameter.
   4. Placement and Compaction:
      a. Sanitary Sewer Trenches: Backfill material will be placed by hand in 6 inches (152.4 mm) loose layers and tamped to a point 2 feet (60.96 cm) above the outside top of the pipe. Backfill will be compacted with suitable mechanical tamping equipment with special care being taken not to damage the pipe or joints. Use of compaction equipment directly above semi-rigid and flexible pipe should be avoided until sufficient backfill has been placed to ensure that the equipment will not damage the pipe. A minimum of [36] inches ([914.4] mm) of compacted backfill above the top of semi-rigid and flexible pipe will be in place before wheel loading and a minimum of [48] inches ([1219.2] mm) of compacted backfill before use of pneumatic tampers. From these elevations to the subgrade elevation of the pavement, bottom of the sod, or to the original ground surface, suitable backfill will be mechanically placed in [9] inch ([228.6] mm), maximum, loose layers. All backfill material will be compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698).
   5. Manholes and Special Structures: When the masonry or concrete work has set sufficiently to withstand compaction, and the Engineer authorizes, backfill material will be placed in 6 inch (152.4 mm) loose layers and compacted with heavy tampers or pneumatic tampers to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698). Suitable backfills will be placed in this manner from the foundation of the structure to the subgrade elevation of the pavement, the bottom of the sod or to the original ground surface.

C. Open Areas and Unimproved Property

   Backfill Material: Backfill of excavations on unimproved property will be made with select material from the top level of bedding material or foundation to the surface. Non-granular select material to be used for backfilling will be free from debris, organic matter and perishable compressible material, and will contain no stones, lumps or rock fragments larger than 6 inches (152.4 mm). Rocks or lumps smaller than 6 inches in diameter will not exceed an amount that will interfere with the consolidating properties of the fill material. No rocks or lumps will come in direct contact with the pipe. Stones and lumps will be kept separated and well distributed, and all voids will be completely filled with fine material.

   1. Placement of Backfill: Backfill procedures specified in the Earth Moving Specifications will apply from the trench bottom to a point 2 feet (60.96 cm) above the outside of the pipe. From this point to slightly above the surrounding surface elevation, suitable backfill may be

placed by bulldozer or other mechanical means.

D. Sanitary Sewer Facilities Placed on Fill
   1. All sanitary sewer pipes laid on fill will be ductile iron pipe. Fill material placed in areas over which sanitary sewer facilities will be constructed will be selected, job- excavated earth from the original ground to the subgrade elevation of the facility.
   2. The fill material will be placed in 6 inch (152.4 mm) loose layers and compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 690) up to a point at least [2] feet ([60.96] cm) above the outside top of the pipe or to the foundation of manholes or special structures. If compaction standards for the sanitary sewer exceed that of the adjoining fill, the width of compaction for a sanitary sewer will be not less than the outside diameter of pipe plus [10] feet ([304.8] cm). If compaction standards for the sanitary manhole or special structure exceed that of adjoining fill, the limits of compaction for the structure will be not less than [5] feet ([152.4] cm) outside the structure base slab.

E. Removal of Excess Material
   1. After the trench or excavation has been properly backfilled, all excess dirt will be removed from the streets, roadways and improved private property so pavements or turfed areas may be replaced and properties cleaned.
   2. In open areas and unimproved property, the excess material may be used to fill low spots on property next to the right-of-way/easement. Before spreading excess soil, the Contractor will obtain written permission from the property owner for the spreading of excess soil, and a copy of the written permission will be submitted to the Engineer. Such spreading or filling will not obstruct surface drainage and be to the satisfaction of the property owner. Excess material will be disposed of by the Contractor.

PART 4 - FINAL TESTING AND ACCEPTANCE

4.01 VISUAL INPECTION

A. All work will be subject to visual inspection for faults or defects, and any such deviation or omission will be corrected at once. All tests will be made by the Contractor who will provide necessary equipment for testing and lamping the system in the presence of and under the supervision and instructions of the Engineer. Lamp tests will be observed firsthand by the Engineer. Each section of sewer line will show a full circle of light when lamped between manholes. All defects located will be corrected before conducting leakage tests.

4.02 LEAKAGE TESTS

A. Leakage tests will be performed on the full length of all sewer lines and manholes in the presence of the Engineer before acceptance. The cost of all testing will be included in the unit price for the item being tested.

B. Exfiltration Leakage Test

   This section will only apply to pipes larger than 24 inches (609.6 mm) and smaller than 48 inches (1219.2 mm) in diameter. All pipes over 48 inches in diameter will have individual joint testing according to these Specifications. The method of testing used by the Contractor will be subject to approval by the Engineer. The Contractor will provide all required testing apparatus. The method adopted must exert a minimum internal water pressure of four feet. This hydrostatic head will be measured from the inside top of the pipe at the high end of the section being tested. The height of the water level at the beginning of the test must be high enough so that the 4-foot head will be standing at the end of the test. The maximum hydrostatic head is limited to [15] feet ([457.2] cm). The exfiltration test will be maintained for at least two hours on each reach between manholes as necessary to find all leaks. The trench and backfill are intended to be free of excess water.

   1. In areas where groundwater is known to exist, a one-half inch diameter capped pipe nipple approximately 10 inches (254 mm) long will be installed through the manhole wall on top of the lowest sewer line entering the manhole. This will be done at the time the sewer line is installed. Immediately before the performance of the leakage test, the groundwater level will be determined by removing pipe cap, blowing air through pipe nipples into the ground to clear it, and then connecting a clear plastic tube to the nipple. The tube will be held vertically and a measurement of height in feet of water will be taken after the water stops rising in this plastic tube. The height in feet will be divided by 2.3 to establish the pounds of

pressure that will be added to all readings. In the event there is water present in the trench or backfill at the time of the test, the required head producing the pressure inside the pipe must be raised to offset the counteracting pressure outside of the pipe. The test will not be considered satisfactory until an acceptable method of measurement shows that the exfiltration rate does not exceed 0 gallons per inch of internal diameter per mile of pipe per day for each reach tested.

2. An initial test must be arranged by the Contractor so that the first reach of each size laid by each crew at the beginning of the workday can be tested before the backfill has been completed, but the pipe will be backfilled to a point 2 feet (60.96 cm) above the outside top of the pipe. This test reach is intended to extend only to the next proposed manhole location. However, if conditions are justified, the length of the test reach may be reduced but never will this reach be less than 100 feet (3048 cm). No further pipe laying will be permitted by this crew until the above-described test has been satisfied. All remaining pipes will be subject to the exfiltration test after manholes have been constructed and backfill placed. Manholes are to be included in this test and will be considered as sections of pipe equal to the diameter of the manhole.
3. If anytime the exfiltration observed and measured by the Engineer exceeds 0 gallons per inch of internal diameter per mile of sewer per day, the Contractor will find the point(s) of leakage and will make necessary repairs and then retest the same reach. The Contractor will submit his plans for repair to the Engineer for his review.
4. Water used for testing will be removed from the test to reach following acceptance and will be disposed of properly. Water used for testing will not be discharged in such a manner to damage other construction or public or private property. The cost of providing the test water will be borne by the Contractor.

C. Air Leakage Test for 6–24-inch (609.6 mm) Diameter Pipe

1. Upon completion of construction, or earlier if the Engineer deems advisable, the Contractor will provide the necessary equipment and labor to perform low pressure air tests according to ASTM F1417. This test will be performed in the presence of the Engineer and will be for all types of gravity sewer pipe. This test will also include service lines from manholes.
2. The pressure test gauge will meet the following minimum specifications:
   a. Size (diameter): 4-1/2 inches (114 mm)
   b. Pressure range: 0-15 PSI
   c. Figure intervals: 1 PSI Increments
   d. Minor subdivisions: 0.05 PSI
   e. Pressure tube: Bourdon Tube or diaphragm
   f. Accuracy: Plus or minus 0.25% of Maximum scale reading
   g. Dial: White coated aluminum with black lettering, 270°arc and mirror edges
   h. Pipe connection: Low male /, inch NPT
3. Calibration data will be supplied with all pressure test gauges. Certification of pressure test gauges will be required from the gauge manufacturer. This certification and calibration data will be available to the Engineer whenever air tests are done.
   Air leakage tests will be performed on each reach of sewer pipe between manholes after completion of the installation of pipe and appurtenances and the backfill of sewer trenches. The test time will be determined from the following table. If air tests fail to meet the following requirements, repeat tests as necessary after all leaks and defects have been repaired. Before acceptance. The same sewer reach will pass the low-pressure air test.

Time Required for a 1.0 psig (6.89 kPa) Pressure Drop for Size and Length of Pipe Indicated1

Pipe Diameter (in)	Minimum Time (min:sec)	Test Time for Length of Sewer Tested (min)
6	5:40	0.854 X L(ft)/60
8	7:34	1.52 X L(It)/60
10	9:26	2.374 X L(ft)/60
12	11:20	3.418 X L(ft)/60
15	14:10	5.342 X L(ft)/60
18	17:00	7.692 X L(ft)/60

21	19:50	10.47 X L(ft)/60
24	22:47	13.674 X L(ft)/60

1 Establish the test time for the sewer length from the formula or the minimum time, whichever is greater.

D. Infiltration Test
   1. Infiltration tests may be required for the complete line or any portion of it. Failure of any part of the line to pass an infiltration test will be sufficient reason to require additional work by the Contractor to reduce the infiltration in such portions of the line tested. The passing of an infiltration test will in no way relieve the Contractor of any responsibility to repair visible leaks found during the visual inspection.
   2. Maximum allowable infiltration will be 0 gallons per mile per inch of diameter of sewer per 24-hour day at a time. The joints wlll be tight, and visible leakage in the joints of leakage greater than that specified above will be repaired at the Contractor's expense by any means necessary.

E. Joint Acceptance Testing
   1. Individual joints will be tested for pipe diameters of 48 inches (1219.2 mm) and greater. Testing will be performed according to ASTM C 1103.

4.03 DEFLECTION TEST – SEMIRIGID AND FLEXIBLE PIPE

A. All polyvinyl chloride (PVC) pipes and glass fiber reinforced polymer mortar pipes will be tested for deflection. All testing will take place after backfilling has been in place at least 30 days. All lines will be thoroughly cleaned before testing to assure accuracy.

B. Tests will be run using a rigid ball or nine arm mandrels having a diameter of 95% of the inside diameter of the pipe for PVC and 96% of the inside diameter of the pipe for glass fiber reinforced polymer mortar pipe. The mandrel will be pulled freely by hand through the pipe from manhole to manhole. No pipe deflection will exceed 5% for PVC and 4% for glass fiber reinforced polymer mortar pipe. Any section failing the test will be repaired by re-beddin9 ‹ pipe replacement and retested to the satisfaction of the Engineer.

C. The cost of this service will be included in the unit price bid for the pipe.

4.04 FINAL ACCEPTANCE

A. When all work required by the Contract has been completed, the Contractor shall submit to the Engineer written certification from a registered land surveyor that the centerline of each structure is within 2.0 feet (60.96 cm) of the centerline of the sewer easement or the location designated on the plans. After receiving the surveyor's certification from the Contractor, the Engineer will make a final inspection of the Work, including any tests for operation. After completion of this inspection the Engineer will, if all things are satisfactory to him, issue to the Contractor a Certificate of Completion certifying that the Work required by the Contract has been completed according to the Contract Drawings and Specifications. However, the Certificate will not operate to release the Contractor or his sureties from any guarantees under the Contract or the Performance Bond. Upon receipt of the Certificate of Completion the Contractor will clean the premises and see that they are in an orderly condition.

DIVISION 33 42 00 – STORMWATER GRAVITY PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. This work shall consist of the construction of storm drain pipe of the kinds and dimensions shown on the Plans, stipulated in the Contract Documents. The construction shall be accomplished in accordance with these Specifications and in conformity with the lines, grades, and details shown on the Plans or established by the Owner. The work shall include such labor, material, equipment, bedding, laying pipe, making joints, tunneling or jacking, encasement, foundation concrete, connection to other drainage structures, abandonment or removal of pipe, and all other items as may be necessary to complete the storm drains as shown on the Plans.

1.02 NEW MATERIALS

A. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Unless otherwise specified all materials incorporated into the work shall be new and unused in previous construction. Used materials in acceptable condition may be used for trench bracing,

forms, falsework, and similar uses.

1.03 MANUFACTURER'S QUALIFICATIONS

A. The source of supply for each material to be supplied by the Contractor shall be subject to approval by the Engineer before orders are placed. Storm drainage pipe shall be the standard product of a manufacturer of established good reputation in the industry and manufactured in a permanent plant adapted to meet the specified design requirements of the pipe.

1.04 INSPECTION AND TESTING

A. Representative samples of materials intended for incorporation in the work shall be submitted for examination when so specified or requested. All materials to be used in the work shall be sampled, inspected, and tested in accordance with current ASTM specifications, or other specified standard specifications. The Contractor shall furnish the Engineer with three copies of certified reports from a reputable testing laboratory showing the results of the tests carried out on representative samples of materials delivered and to be used in the project. The performance of all testing shall be done at no cost to the project.

B. The Contractor shall notify the Engineer in advance of any deliveries of the materials and shall make whatever provisions are necessary, including the furnishing of such labor as may be required to aid the Engineer in the examination, and culling of the materials on the site prior to installation in the work.

C. All materials not conforming to the requirements of these Specifications shall be considered as defective and rejected for use and shall be removed from the site of the work.

1.05 STORAGE

A. The Contractor shall provide such storage facilities and exercise such measures as will ensure the preservation of the specified quality and fitness of materials to be incorporated in the work.

1.06 ACTION SUBMITTALS

A. Pipe materials for each type of pipe proposed for the Work.

PART 2 – PRODUCTS

2.01 REINFORCED CONCRETE PIPE

A. All reinforced concrete pipes shall conform to the requirements of ASTM Standards for the specified diameter and strength class as follows:
   1. Circular Pipe – ASTM C 76 – Wall B

B. Strength class or classes shall be as required by the Plans or Contract Documents but in no case shall pipe of less than strength Class III be used. The interior surfaces of the pipe shall be a smooth, true cylindrical surface free from undulations or corrugations. Bungholes for lifting drain pipe shall be eliminated with the exception of radius pipe, manhole sections and elliptical pipe. Lift holes are to be provided for radius and elliptical pipe and manhole sections only. Lifting holes when provided shall be cast in the wall of the pipe to receive a precast truncated conical concrete plug of such size as will allow 1/8 inch (3.18 mm) cementing material on the sides of the joining surfaces of the plug and will fill at least 50 percent of the lifting hole depth. Cement shall meet all the requirements of the specifications for Portland Cement, ASTM C 150, Type II.

C. Joints in reinforced concrete pipe shall conform to one of the following types:
   1. Rubber Trapped "O" Ring Gasket type – ASTM C 443
   2. Flexible Plastic Rope Gasket type – AASHTO M 198 – Type B
   3. Flexible Butyl Rope Gasket type – AASHTO M 198 – Type A
   4. Portland Cement Mortar Joint type

2.02 HDPE PIPE:

A. ADS N-12 (Dual wall, watertight) in accordance with ASTM F2648.

2.03 MORTAR

A. Mortar shall be composed of one part Portland cement, two parts masonry sand, hydrated lime not to exceed 10 percent of the cement used, and 4 parts water. All ingredients shall be proportioned by measurement and not by estimation. All Portland cement, sand, and water shall be as specified in this Specification. All hydrated lime shall be as specified by ASTM C 6.

B. The mortar shall be hand mixed or machine mixed. In the preparation of hand mixed mortar, the sand, cement and hydrated lime shall be thoroughly mixed together in a clean, tight, mortar box until the mixture is of uniform color, after which water shall be added. Machine mixed mortar shall be prepared in an approved mixer and shall be mixed not less than 1½ minutes. Mortar shall be used within 30 minutes after mixing.

C. Precast manhole sections, radius pipe and elliptical pipe lifting holes shall be filled with a non-shrinking grout from the outside and inside. Grout shall be set firmly before backfilling around structures.

2.04 FIELD PERIMETER DRAINAGE SYSTEM

A. PRO-S Channel Drain System by SportsEdge (www.sportsedge.com) PART 3 - EXECUTION

PART 3 EXECUTION

3.01 MODIFICATION OF EXISTING STORM DRAIN

A. Abandonment of Drainage Pipe Protect existing site improvements to remain from damage during construction.
   1. Drainage pipe to be abandoned shall be sealed by mortaring (bricking) the end of the pipe for a distance of 18 inches (457.2 mm) minimum, or one-half the diameter of the pipe, whichever is larger. The pipe shall be sealed with solid concrete block or brick and acceptable cement grout to form a solid waterproof plug completely bonded to the pipe, unless otherwise specified.
   2. The Contractor will be allowed to remove that portion of the pipe to be abandoned in lieu of filling and blocking. If the Contractor elects the removal method, all costs for backfilling the excavation and all costs for surface restoration, in addition to removing and properly disposing of the pipe, shall be included in the unit bid price for Abandonment.

3.02 CONNECTION TO EXISTING STRUCTURES

The Contractor shall cut suitable openings as approved by the Owner into existing structures or remove existing pipe to accommodate the drain pipe if at the proper elevation, location, and direction, as indicated on the Plans. The existing pipe shall be removed or a hole cut in the structure wall to permit inserting the drain pipe at the required flow line elevation, horizontal angle, and slope, and to allow [2] inches ([50.8] mm) space around the pipe for bedding and filling solidly with mortar. Care shall be used to avoid unnecessary damage to the existing masonry.

A. All loose materials shall be removed from the cut surfaces, which shall be completely coated with mortar before setting the pipe. If the structure wall is reinforced concrete, a cage of steel reinforcement shall be installed and the existing bars reshaped and tied to the cage around the entire pipe before mortar is placed in accordance with the Design Standard. Before inserting the pipe, a sufficient thickness of mortar shall be placed at the bottom and sides of the opening for proper bedding of the pipe. After setting, all spaces around the pipe shall be solidly filled with mortar and neatly pointed up on the inside to present a smooth joint, flush with the inner wall surface. Any necessary revisions in the existing invert shall be made to provide a smooth plastered surface for properly channeled drainage from the new connection. Particular care shall be given to ensure that the earth subbase and bedding adjacent to the manhole will provide firm solid support to the pipe.

3.03 REMOVAL OF DRAINAGE PIPE

A. Existing pipes to be removed and their locations are shown on the Plans. The Owner reserves the right to retain or reject salvage of any materials encountered. All remaining materials become the property of the Contractor who will be responsible for properly disposing of same off-site. All pipes whose removal is required to facilitate the installation of the proposed drainage facilities shall be removed without separate measurements or payment. This work shall be included in the price of the new drainage facility.

3.04 STORM DRAIN PIPE INSTALLATION

A. General. Drain pipe and bedding shall be constructed of the sizes, classes, dimensions, and materials and to the alignments and grades shown on the Plans.
B. Pipe Bedding. Bedding for drainage pipe shall be shown on the Plans.
C. Pipe Laying.
   1. Inspection Before Laying. The Contractor shall inspect all pipe upon delivery and such pipe as does not conform to the requirements of these Specifications and which are not suitable for use shall be rejected and immediately removed from the work site.
   2. Pipe Ends Cleaned and Lubricated Before Laying. Preparatory to making pipe joints, all surfaces of the portions of the pipe to be jointed or of the factory-made jointing materials shall be clean and dry. All necessary lubricants, primer, adhesives, etc., shall be used as recommended by the pipe or joint manufacturer's specifications.

3. Care During Hoisting, Placing, and Shoving Home. Equipment used to handle, lay and joint pipe shall be so equipped and used as to prevent damage to the pipe and its jointing materials. All pipe and fittings shall be carefully handled and lowered into the trench. Damaged pipe or jointing material will not be accepted and shall not be installed. All rejected material shall be removed from the job site.
4. Uniform Pipe Bearing.
    a. Special care shall be taken to ensure that the pipe is solidly and uniformly bedded, cradled, or encased in accordance with the type of bedding, cradle, or encasement required by the Plans. No pipe shall be brought into position for joining until the preceding length has been bedded, joined and secured in place.
    b. Where a concrete cradle is required, the pipe shall be supported at not more than two places with masonry supports of minimum size sufficient to provide the required clearance and to prevent displacement during placing of concrete.
5. Direction of Work. The laying of pipe in finished trenches shall be commenced at the lowest point. When installed the bell or grooved end shall be forward or upgrade. All pipes shall be laid with ends abutting and true to line and grade. They shall be carefully centered so that when laid they will form a drain with a uniform invert.
6. Alignment and Grade. Each piece of pipe shall be checked for vertical and horizontal alignment immediately after being laid.
7. Bedding to Secure Pipe. As soon as possible after the joint is made, sufficient material shall be placed alongside each side of the pipe to offset conditions that might tend to move the pipe off line and grade. Particular care shall be used to prevent disturbance or damage to the pipe and the joints during backfilling.
8. Flotation and Water in the Trench.
    a. The Contractor shall take all necessary precautions to prevent flotation of the pipe in the trench.
    b. Water shall not be allowed to rise in the trench until the joint materials, and any concrete cradle or encasement is hardened and cannot be damaged by the water.
9. Open Ends. Whenever pipe laying is stopped for any significant length of time, such as at the end of a workday, the unfinished end shall be protected from displacement, flotation, cave-in, in-wash of soil or debris, or other injuries. A suitable temporary tight-fitting plug, stopper, or bulkhead shall be placed in the exposed ends of the pipe.

D. Pipe Joint.
1. General.
    a. Jointing operations shall continue immediately following the laying of such pipe section. In no case shall any pipe section be left overnight which has
        1) not been completely jointed to the preceding pipe section in conformance with these Specifications.
    b. No composition or asphalt base joint material shall be used to seal pipe joints.
    c. The rubber trapped “O” ring gasket and flat rubber gasket shall be used on all drain pipe on C.I.P. Projects. In sub-divisions the flexible butyl gasket joint may be used outside of the street right-of-way; the rubber gasket shall be used in the street right-of-way. The butyl gasket material may be placed on the end of the spigot only (not in the bell). See Specification Section 02632 Paragraph 3.04.
2. Concrete Pipe.
    a. Rubber Trapped “O” Ring Gasket Joints:
        1) The two ends to be joined shall be thoroughly cleaned and a rubber gasket compatible with the type of pipe ends to be and a rubber gasket compatible with the type of pipe ends to be joined shall be placed on the tongue or spigot end of the pipe. Care shall be taken to assure even tensioning and uniform cross-section of the gasket around the full circumference of the pipe. When required, lubricant recommended by the joint material manufacturer shall be liberally applied to the gasket and both ends of the pipe immediately before pipe ends are joined. The upstream pipe shall be positioned such that the tongue or spigot may enter the groove or bell squarely.
        2) Suitable means shall be used to force the tongue or spigot end of the pipe into

the groove or bell end without damage to the pipe and its jointing materials, and without disturbing the previously laid pipes and joints. Any pipe or gasket damaged during jointing operations shall be removed and pipe rejointed at the Contractor's expense.

3. Flexible Plastic or Butyl Gasket Joints.
    a. The two ends to be joined shall be thoroughly cleaned. If primers are recommended by the gasket material manufacturer, they shall be applied sufficiently in advance to allow primer to dry prior to placement of gasket material. Protective paper shall be removed from one side of gasket and gasket laid around joint surfaces near center of final gasket position desired. Gasket material may be placed on either the bell or spigot ends of the pipe as well as the tongue or groove ends of pipe. Gasket shall be placed and pressed firmly around the entire circumference of the joint and butted end to end forming a continuous gasket without stretching the gasket material. Care shall be exercised to ensure that the proper gasket size for the associated pipe joint is used. The upstream pipe shall be positioned and remaining protective paper removed. Suitable means shall be used to force the tongue or spigot end of the pipe into the groove or bell end without damage to the pipe and its jointing materials, and without disturbing the previously laid pipes and joints. Pipe shall be shoved home until gasket material is squeezed out of the joint. Squeeze out will be external if gasket material is placed on the
        1) tongue or spigot and internal if on the groove or bell ends of the pipe. All joints not fully filled with gasket material until "squeeze-out" occurs shall be rejoined with new gasket material at the Contractor's expense.

E. Cleaning and Inspection.
1. The interior of the pipe shall, as the work progresses, be cleared of all dirt, cement extruded joint materials, debris, and extraneous materials of every description. On small pipe where cleaning after laying may be difficult, a squeegee shall be kept in the pipe line and pulled forward past each joint immediately after its completion.
2. All work shall be in undamaged condition and constructed properly in accordance with the Plans and Contract Documents. All defects and leaks disclosed by tests shall be remedied. No piping shall be buried, covered, or concealed until it has been inspected, tested, and approved. To do otherwise will be grounds for rejection of the pipe by the Owner. All tests shall be performed by the Contractor under supervision of the Owner.
3. While the pipe is being laid between adjoining structures in each straight or working section of the drain, light from the finished or other end of the section shall remain constantly in plain view throughout the entire length of such section and shall show the true character and shape of the interior surface of the drain. The test shall be applied for each working section after the drain is complete in all respects before it is accepted.
4. Pipe sizes greater than 36 inch (914.4 mm) diameter or equivalent diameter shall be entered and examined while smaller diameter or equivalent diameter pipe shall be visually inspected from each end of the pipe section. Pipe sections shall be visually inspected for debris and obstructions, structural cracks and defects, joint tolerances, joint workmanship, and satisfactory connection to drainage structures.

3.05 FIELD PERMETER DRAIN INSTALLATION

A. Install field perimeter drain in accordance with the manufacturer's instructions.

APPENDIX A - PROCESS IMPROVEMENT CHECKLIST

The "Process Improvement Checklist" is a quality control / quality assurance document used by the Designer involved in producing the Construction Documents to document compliance with the Design Guidelines. The Designer is responsible for completing this checklist and returning it to the Owner for review at each phase of design.

Unless specifically waived by Owner, items on this list and within these guidelines must be incorporated into the Construction Documents. Designers must be granted written permission from Owner to deviate.

DIVISION 0 00: GENERAL

SD	DD	CD	
☐	☐	☐	Design submittal conforms to Master Schedule or extensions have been granted by Owner for appropriate cause. Reason for nonconformance: _____
☐	☐	☐	Building design complies with all applicable building codes, including the American with Disabilities Act.
☐	☐	☐	The design drawings include room names, room numbers, and square footage for each space.
☐	☐	☐	The drawing set includes a Life Safety Floor Plan sheet with all code compliance information, occupancy calculations, UL assemblies and overall building summary including total and individual room square footages.
☐	☐	☐	Site data is listed in a box in the lower right corner of civil drawings and includes site area by acreage, total number of parking spaces, street address, and recorded book and parcel number.
☐	☐	☐	Fire walls are specified to receive stenciled wall rating labels above the ceiling.
☐	☐	☐	UL designs for floor and ceiling assemblies avoid the use of spray-on fireproofing.
☐	☐	☐	All items to be demolished are noted on Demolition Plans.
☐	☐	☐	Downspouts are designed to drain into underground systems and have protection up to two feet above ground. Splash blocks are indicated in locations where underground systems are technically infeasible. Drains to daylight assure positive drainage away from building and prevention of erosion.
☐	☐	☐	Inter-discipline clashes are resolved and drawing sections are provided to clarify relationships of piping, ducts, etc.
☐	☐	☐	Unit Prices in the bid documents are coordinated with Owner.
☐	☐	☐	Drawings and specifications are fully coordinated between all disciplines involved in the design process.
☐	☐	☐	Interior roof drains and thru-wall scuppers, where applicable, are designed approved by Owner.
☐	☐	☐	Roof penetrations – including vents, rooftop units, roof ladders, and flashings – are minimized and consolidated.
☐	☐	☐	Preferred materials are designed on exterior shell and EIFS is excluded above ground reach (12'-0" above grade).
☐	☐	☐	Code required assemblies are appropriately detailed in Construction Documents and avoid delegated design.
☐	☐	☐	Building design complies with radon exposure regulations.
☐	☐	☐	Elementary school playground areas are identified on site plans to be provided under a separate contract by Owner.
☐	☐	☐	Drawings and specifications do not contradict Owner provided front-end and Instructions to Bidders (ITB).
☐	☐	☐	High, flat sills and ledges are avoided in the design.
☐	☐	☐	Construction documents include design for 4' x 8' job site sign constructed of plywood and exterior wood trim painted to resist weather. Information on signs includes: • Name of the School

- Names of Contractor and Designers
- Names of the Board of Education members at the time of award of the design contract
- Name of the MSCS Superintendent
- Logo of Memphis-Shelby County Schools

☐ ☐ ☐ State Fire Marshal plan review fees are calculated at 50% of schedule for Memphis-Shelby County Schools.

☐ ☐ ☐ Section 01 32 16 – Construction Progress Schedule is included in specifications for all projects of over $1,000,000 in value.

☐ ☐ ☐ Spaces used by pre-kindergarten through first grade students including library, cafeteria, music, art and support spaces are located on the ground floor or are provided access by a dedicated stair.

☐ ☐ ☐ Asbestos-containing materials are specifically excluded in the construction project. A statement disallowing the use of such materials is included in the Construction Documents.

DIVISION 4 00: MASONRY

☐ ☐ ☐ Bullnose block is detailed at outside corners of interior concrete masonry unit walls (except for first course above the slab).

☐ ☐ ☐ Control joint locations are defined on floor plans or elevations.

☐ ☐ ☐ Brick design and specification utilize readily available sizes, shapes, and colors.

☐ ☐ ☐ Wall cavities detail spray-applied insulation on exterior block continuously from footing to roof deck.

DIVISION 5 00: METALS

☐ ☐ ☐ Guardrails and handrails have vertical picket design and avoid horizontal ladder-type rungs.

☐ ☐ ☐ Concrete filled stair pans are detailed in lieu of steel stair treads.

☐ ☐ ☐ Acoustic roof decking is detailed at a minimum in Playrooms, Cafeteria / Dining Rooms, Band Rooms, Choir Rooms, and Gyms.

DIVISION 6 00: WOOD, PLASTICS, AND COMPOSITES

☐ ☐ ☐ Warp prevention is specified for tall laminate casework doors.

☐ ☐ ☐ Millwork and Casework are specified to be supplied by approved Division 12 or AWI approved Division 6 Cabinet Manufacturer according to guideline specifications.

☐ ☐ ☐ Rubber base is detailed to be installed on cabinet bases.

☐ ☐ ☐ Administrative mailboxes are minimum 12” wide x 6” high x 12” deep and are designed to allow for name tags. Mailbox quantity has been validated by principal and allows for expansion.

DIVISION 7 00: THERMAL AND MOISTURE PROTECTION

☐ ☐ ☐ Roof inspection is complete prior to warranty issue. Inspection report and warranty document are included in Close Out documents.

☐ ☐ ☐ High/Low roofs and exterior wall penetrations have adequate detailing.

☐ ☐ ☐ Roof structure is sloped a minimum of ¼” per for and tapered insulation is used minimally. Lightweight insulating concrete is avoided.

DIVISION 8 00: OPENINGS

- ☐ ☐ ☐ Standard glazing units are specified and utilize common shapes, colors, and sizes.
- ☐ ☐ ☐ Thermally broken aluminum frames are specified with insulating glass to meet current energy codes.
- ☐ ☐ ☐ Windowsill heights in Media/Library are coordinated with furniture.
- ☐ ☐ ☐ View window between Kitchen and Kitchen Office has sill height of 44".
- ☐ ☐ ☐ Windowsills in Elementary classrooms with in-room lockers are coordinated with lockers, including base and countertop.
- ☐ ☐ ☐ Door hardware schedules and specifications are coordinated with Owner preferred hardware consultant.
- ☐ ☐ ☐ Specifications indicate locksets to be keyed to match between classrooms and storage rooms inside classrooms.
- ☐ ☐ ☐ Specifications indicate locksets in building additions to be keyed to existing building master key system.
- ☐ ☐ ☐ All exterior doors are recessed or protected by canopy or structure from direct rain and snow exposure.
- ☐ ☐ ☐ Double doors include removable center mullion for latching and avoid vertical rod hardware.
- ☐ ☐ ☐ Door leaves are 3'-0" wide minimum.
- ☐ ☐ ☐ Heavy duty, vandal resistant door hardware and trim are specified.
- ☐ ☐ ☐ Combination door closer/magnetic hold open devices are excluded from hardware specification.
- ☐ ☐ ☐ Floor recessed door closers are excluded from hardware specification.
- ☐ ☐ ☐ Panic hardware locations are fully coordinated between view windows and kick plates.
- ☐ ☐ ☐ Path and doors to kitchen are wide enough to accommodate movement of kitchen equipment (min. 42" for single doors).
- ☐ ☐ ☐ Maneuvering paths and door clearances are appropriate for mechanical equipment in boiler and mechanical rooms.
- ☐ ☐ ☐ Path between Music Room and Auditorium or Gym is appropriate for maneuvering a Grand Piano. Double doors are permitted with removable (keyed) mullions.
- ☐ ☐ ☐ Exterior accessed lawn mower storage rooms have at least one 48" door.
- ☐ ☐ ☐ Fire rated coiling doors with manual resets are avoided in the design and specifications. Use of this type of door must be approved in writing by MSCS.
- ☐ ☐ ☐ Wood doors with clear finish are specified as AWI premium grade plain sliced select white birch.
- ☐ ☐ ☐ A Doorbell is included, along with peep hole at kitchen delivery door.

DIVISION 9 00: FINISHES

- ☐ ☐ ☐ Finish boards are approved by Owner.
- ☐ ☐ ☐ Acoustic wall or ceiling panels are detailed in Play Rooms, Gyms, Band Rooms, Choir Rooms, Practice Rooms, and Cafeterias.
- ☐ ☐ ☐ Where ceilings are part of rated design, UL design numbers are noted on ceiling plans.
- ☐ ☐ ☐ Final facility cleaning and preparation of building, including sealing and waxing, is included in specifications to be performed by Contractor.
- ☐ ☐ ☐ Floor material spec addresses final clean and polishing such as burnishing, polishing or waxing. Wax brand and type is coordinated with Owner.
- ☐ ☐ ☐ Porous flooring spec addresses machine scrubbing floors and application of 2 coats of sealer. Sealer brand and type is coordinated with Owner.
- ☐ ☐ ☐ Quarry Tile spec indicates preferred grout joints.
- ☐ ☐ ☐ In building remodels, suspected asbestos containing materials are noted to follow Federal Guidelines for asbestos removal.

DIVISION 10 00: SPECIALTIES

☐ ☐ ☐ Toilet tissue dispensers, soap dispensers, and paper towel dispensers are specified as owner-provided, contractor-installed.

☐ ☐ ☐ Lockers are specified to receive metal bases.

☐ ☐ ☐ Toilet partitions are specified as with full height stainless steel hardware and 20 degree opening continuous hinges.

☐ ☐ ☐ Exterior building signage includes school name and building number in applied lettering mounted 12 feet or more above grade.

☐ ☐ ☐ Interior building dedication plaque is designed to include the following information:

- Month and year opened
- Name of the School
- Names of Contractor and Designers
- Names of the Board of Education members at the time of award of the design contract
- Name of the MSCS Superintendent

☐ ☐ ☐ Exterior marquee sign design includes school name and building address.

☐ ☐ ☐ Fire Extinguishers are located as required throughout the building and are in recessed or semi-recessed fire extinguisher cabinets.

DIVISION 11 00: EQUIPMENT

☐ ☐ ☐ Doors at kitchen tray returns specify type for the soiled dish run and backsplash.

☐ ☐ ☐ Kitchen equipment is specified to be connected by Contractor.

☐ ☐ ☐ Specified scoreboard manufacturer is confirmed to have a maintenance contract in place with MSCS Maintenance.

DIVISION 12 00: FURNISHINGS

☐ ☐ ☐ Window shades are specified and detailed with 6% perforated open area.

☐ ☐ ☐ Furniture layout is fully coordinated with windowsill heights, floor or wall mounted devices, and power (where applicable).

DIVISION 13 00: SPECIAL CONSTRUCTION

☐ ☐ ☐ Bleachers

DIVISION 14 00: CONVEYING EQUIPMENT

☐ ☐ ☐ Emergency telephone with 24-hour monitoring service and keyed call stations are included in Elevator specification.

DIVISION 22 00: PLUMBING

☐ ☐ ☐ Hand sinks in kitchen are specified with splash guards.

☐ ☐ ☐ Floor sinks and drains are designed with positive slopes in kitchens and areas where quarry tile or ceramic tile is specified.

☐ ☐ ☐ Floor sinks in kitchen are specified minimum 12” x 12” stainless steel or brass body with stainless grate and 4” diameter drain.

☐ ☐ ☐ Vents through roof are designed at least 10’ from fresh air intakes.

☐ ☐ ☐ Fire hydrant location and Siamese fire hose connections are coordinated with State Fire Marshal.

☐ ☐ ☐ Discharge from grease trap is routed directly to public sewer or to building sanitary downstream as far as practical.

☐ ☐ ☐ Mop sinks in custodial closets are specified as floor mounted.

☐ ☐ ☐ Sprinkler valves and other accessible valves are designed with locks.

☐ ☐ ☐ At least one water cooler is provided in the Cafeteria.

☐ ☐ ☐ Gas lines are indicated on site plans and meter location is coordinated with gas company.

☐ ☐ ☐ Plumbing supply pipes and valves are located in accessible spaces.

☐ ☐ ☐ Emergency shower and eyewash station are located in the Central Receiving area.

☐ ☐ ☐ Drinking bubbler spouts, guards, sink faucets and similar items are specified to be chrome plated brass or solid metal.

☐ ☐ ☐ Metered faucets are specified for hand washing stations.

☐ ☐ ☐ In-sink drench hose spray and eye wash stations are specified in lieu of emergency shower units.

☐ ☐ ☐ MSCS HVAC personnel have provided water treatment requirements.

DIVISION 23 00: HEATING, VENTILATING, AIR CONDITIONING (HVAC)

☐ ☐ ☐ Cooling towers are enclosed with fence or other secure structures accessible to maintenance personnel only.

☐ ☐ ☐ Cooling towers are designed to gravity flow from tower to mechanical equipment.

☐ ☐ ☐ Heaters in boiler and equipment rooms are sized to prevent equipment from freezing.

☐ ☐ ☐ Mechanical systems utilizing boilers and cooling towers are designed with independent heat exchangers.

☐ ☐ ☐ Testing and Balancing is specified as Owner furnished. T&B reports are included in Close-Out documents.

☐ ☐ ☐ Separate HVAC system is designed for IT Head End room to maintain required set points.

☐ ☐ ☐ Cooling only is provided in all IDF distribution closets.

☐ ☐ ☐ Refrigeration pipe insulation exposed to the elements is detailed with aluminum or PVC cladding.

DIVISION 25 00: INTEGRATED AUTOMATION

☐ ☐ ☐ Energy Management systems include high temperature alarms for both walk-in cooler and walk-in freezers in Kitchen.

DIVISION 26 00: ELECTRICAL

☐ ☐ ☐ Plans have been submitted to NES and NES fees have been identified.

☐ ☐ ☐ Electrical disconnect boxes are located remote from water sources (such as hose reels) in Kitchen.

☐ ☐ ☐ Exterior luminaires are located remote from fresh air and condenser intakes.

☐ ☐ ☐ Powered equipment is coordinated in electrical drawings.

☐ ☐ ☐ Computer circuits are dedicated and panel has surge protection.

☐ ☐ ☐ Motor starters and necessary circuits are shown on drawings for all electric motors requiring starters.

☐ ☐ ☐ Fluorescent light fixtures specify electronic ballasts and T-8 lamps.

☐ ☐ ☐ Electrical outlets and other wall mounted devices are coordinated with casework, tack boards, and marker boards.

☐ ☐ ☐ Luminaires in Band, Chorus, Auditorium and other critical sound areas are appropriate for the functions of the space.

☐ ☐ ☐ Light fixtures in gym are specified with wire guards.

☐ ☐ ☐ Corridor circuits support 15-20 amp loads and are isolated from other rooms and appliances.

☐ ☐ ☐ Exterior disconnect switches are vandal proof and lockable.

☐ ☐ ☐ Each janitor closet includes at least one 110v outlet.

☐ ☐ ☐ Main janitor office includes 110v and 220/208v outlets.

☐ ☐ ☐ Mechanical rooms and Elevator Equipment rooms are designed with adequate lighting.

☐ ☐ ☐ Lighting design integrates combination emergency lights and fluorescent luminaires where required. Gyms and PE Rooms specify battery operated emergency lights detailed to mount at maximum code allowable elevation. Wire guards are specified in these locations.

DIVISION 27 00: COMMUNICATIONS

☐ ☐ ☐ Owner provided IT drawings are coordinated and integrated into electrical package.

☐ ☐ ☐ Data drop is located at energy management panel.

☐ ☐ ☐ Grounding buss bar is included for all IT equipment racks.

☐ ☐ ☐ Network cable is specified as Owner-furnished for coordination with General Contractor.

DIVISION 28 00: ELECTRONIC SAFETY AND SECURITY

☐ ☐ ☐ Tamper Detection Covers are specified for all fire alarm pull stations in Middle and High Schools.

☐ ☐ ☐ Fire alarm annunciator panel, pull station, and alarm silencing are included in the

Administrative Office.

☐	☐	☐	Ionization type smoke detectors are specified in ductwork in lieu of photoelectric type.
☐	☐	☐	Fire alarm strobes and horns are detailed to mount at maximum code allowable elevation. Wire guards are specified in Middle and High Schools.
☐	☐	☐	Fire alarm system and branches are designed with surge protection.
☐	☐	☐	Fire Marshal Emergency Communication requirements are met with Owner furnished phone and intercom system.

DIVISION 31 00: SITE WORK

☐	☐	☐	Drawings clearly indicate extent and locations of sod, including Bio-swale areas.
☐	☐	☐	Landscape plans identify all known easements and utilities, both overhead and underground. Tall trees and significant plantings are avoided under power lines or near underground utilities.
☐	☐	☐	Landscape plans have been reviewed by the Shelby County.
☐	☐	☐	Fire hydrant locations are located near paved drives and accommodate fire engine access and maneuverability. Location has been coordinated with Fire Marshal's office.
☐	☐	☐	Critical points for site borings, rock cores, etc. are coordinated by designer and identified for Owner's testing agency.
☐	☐	☐	Slopes greater than 1:3 are designed with protective barriers along tops of locations and are specified with ground cover vegetation that requires minimal maintenance.
☐	☐	☐	Locations for utility meters, transformers, backflow preventers and fire line connections are coordinated with utility companies. Landscaping is designed to screen these utilities and maintains accessibility for maintenance.
☐	☐	☐	Areas designated for school bus maneuverability are designed with minimum turning radius of 35 feet.
☐	☐	☐	Bus and car staging areas are separate and adequate for school population.
☐	☐	☐	A maintenance hole, remote from the building, is indicated in the sanitary sewer line where the grease trap effluent line connects to the main line and at property line

Designer's Certification: *The design of The Project includes and complies with all owner preferences contained in the MSCS Design Guidelines and Process Improvement Checklist for the phase indicated below.*

Designer Signature, SD Phase	Designer Signature, DD Phase	Designer Signature, CD Phase

APPENDIX B - DATA DISTRIBUTION AND SECURITY SYSTEMS

I. PHONE SYSTEMS

These are the key areas where the Phone System shall have specific connections installed (see specifics below):

- Elevator
- Energy Management System
- Fire alarm panel
- Sprinkler / Fire Pump
- All administration personnel locations
- All classrooms and similar occupied spaces

A. General Information:

1. Phone systems are Owner furnished, Owner installed. The building contractor is responsible for providing empty conduits with pull strings and electrical power where located by the MSCS TIS drawings. The Designer must include this information on his plans and coordinate locations during design as needed.
2. Battery Backup power supply is needed (make sure it is provided by Beacon).
3. Caren Wiggins needs to be notified of service line requirements (MSCS DFM PM to submit form letter).

B. Specific information:

1. Locate telephones with the Owner's project manager at the Design Development stage. Each normally occupied space must have a telephone handset. Provide a phone outlet in the food service office with a remote bell in the kitchen.
2. Provide two continuous 4" diameter conduits, with pull strings, from the point of service directly to the "Head-In" room. The "Head-In" room is to be designated during design with input from the Owner's project manager. It will house all voice and data service line connections that enter the building.
3. Provide telephone jack and wiring to Head-In room at the following locations (phone set not required):
   a. Inside the Building Automation and Control System cabinet (usually in the boiler room) (verify dedicated analog line vs. VOIP).
   b. At the location required to serve the elevator (requires dedicated analog line).
   c. Inside the master fire alarm panel (requires dedicated analog line and one Essex line).
4. If the building requires a sprinkler booster pump, provide (2) RJ-11 jacks and wiring from sprinkler pump monitoring panel to Head-In room. This will require 2 dedicated analog lines.
5. The security system utilizes line seizure for off-site monitoring. The contracted security company connects to the punch down block independent of the building phone system.
6. Additionally, several specialized program functions may require additional analog lines for modem operation, etc. These can usually use one of the spare pairs in the normal telephone wiring. Coordinate the requirements with the Principal.
7. Determine the number of telephone handsets with the Owner's project manager.
8. Each classroom shall have an individual ceiling speaker in addition to the speakers in the halls and other rooms. These are for the purpose of announcements and general paging. These may be separated in up to three paging zones and should be coordinated with the principal. Zones may not be needed. The operation of these speakers is through the telephone handset of the principal or secretary. In order to accomplish zoned paging, a zone controller must be ordered with the phone system. In addition, an amplifier for each paging zone must be provided. A tone generator should be provided with the phone system. Paging and speakers are provided with the phone system by Beacon.
9. Provide a minimum of 64 SF of ¾" plywood on the walls of the Head-In room to facilitate mounting of phone system, wiring blocks, controllers and amplifiers, etc. Provide a minimum of (6) 110V duplex outlet for the phone system and amplifiers plus one outlet for security.
10. Coordinate the installation of telephone and data systems, they must be working prior to State Fire Marshall inspection.

11. Phones shall be in place and operational by Substantial Completion to facilitate training of Owner's personnel.
12. The installation of an elevator in any school requires that it be provided with an emergency communication device. This usually takes the form of a dedicated line telephone connected to a specific monitoring company. Verify that this device is provided and working at the time of Substantial Completion.
13. The School Security Department has an ongoing contract for security monitoring of our schools. The equipment installed in the building now uses a line-seizure device on a phone line to provide the connection to the monitoring contractor. No additional phone line is required. It is imperative that this company be contacted and made to understand the importance of schedule and proper installation,
    i.e. no exposed conduit or wiring.
14. If an Energy Management System is provided in the school, a phone line must be provided to the central processing unit so that our Maintenance Department can monitor and operate it from their office location. Coordination with the IT Department is important.
15. If a jockey pump is needed on the sprinkler system, it will require two phone lines (connected to the fire alarm panel) for monitoring. Wiring is required between the pump sensors and the alarm panel.

II. DATA SYSTEMS

1. Coordinate with Owner's project manager and Library and Media Services for the location of network connections in the Media Center.
2. If outlets occur in the floor, they must be specifically dimensioned on the electrical floor plans.
3. In general, three data drops are to be provided in each instructional space. Three ¾" conduits are to be provided above the ceiling from the corridor to the classroom.
4. The current concept for wiring the facility is that copper cable will run from each data drop to an IDF (intermediate distribution frame) where it will be converted to fiber optic cable which will run to the MDF (main distribution frame) in the Head-In room. The Owner's project manager shall coordinate the locations of each IDF throughout the facility. Each IDF will require an isolated 110-volt electric outlet. Any IDF should be inaccessible to student traffic and in a conditioned space.
5. Take precautions that IT sensitive equipment is in a dust free conditioned space.
6. If the plenum space will be used for return air, this condition must be specifically identified to the TIS project manager so that plenum rated cable can be specified.

III. CABLE SYSTEMS

1. The cable from the street into the "Head-In" room will be furnished and installed by the cable company through a building contractor provided 4" conduit as described in 88.
2. Provide a TV outlet in each classroom.
3. Provide TV outlets in the Principal's Office, Media Center, Conference Rooms, etc. as coordinated with the Owner's project manager.
4. Internal wiring for data, telephone, and television is to be installed prior to ceiling installation.
5. Provide surge protected 110V power in the "Head-In" room for cable equipment.
6. Data, telephone and television cabling is Owner furnished, Owner installed in building contractor supplied wire ways.

IV. SECURITY SYSTEMS

1. Jason Boyd, Director of Security, at 901-674-5542.
2. At Design Development, provide floor plans of the building to Security to identify locations for security keypads, Aiphones, cameras, detectors, and other security devices inside and on the exterior of the building. Standard details for boxes to be located for these devices are available and the electrical engineers need to incorporate these boxes into the construction documents. Keypads will typically be near the front entrance, kitchen entrance and custodian entrance. Other devices will be located as the design dictates. Coordinate these locations carefully with the Major Construction team. Keypad installation requires an empty gang box mounted at ADA compliant height A.F.F. with ¾" dia. conduit extended above ceiling. Other device requirements are available.
3. There shall also be a doorbell (ringer or buzzer) at the kitchen for deliveries. There can be more than one choice for its location, coordinate carefully on a school-by-school basis. There shall also be a door viewer at this location.
4. Security will advise you if they need additional electrical above ceiling for signal boosters.
5. Provide space for security equipment in the "Head-In" room along with surge protected 110V power

and analog telephone lines seized from the FAX or other appropriate line. They will share a backboard with others.

6. Contractor to provide a closeout schedule at 50% completion to allow MSCS and contractors to be prepared for building close-out.
7. Installing wiring in the hollow metal frames for security has been deleted from this scope of work.

APPENDIX C -SPRINKLER MONITORING REQUIRED BY FIRE DEPARTMENT

In schools which are sprinkled, monitoring of the sprinkler system by a fire department approved central station monitor is required.

The requirements for monitoring are as follows:
If the project is sprinkled but has no pump, monitor General Alarm, General Trouble, Water Flow and Sprinkler Tamper Switches.

Contractor to provide dry contacts in fire alarm control panel to monitor these functions.
If the project is sprinkled and requires a booster pump to provide water pressure, monitor General Alarm, General Trouble, Water Flow, Sprinkler Tamper Switches, Power Failure at Pump, Phase Reversal, and Pump Running.

Contractor to provide dry contacts in fire alarm control panel to monitor these functions.
Contractor to provide flow meters, tamper switches and other required devices at pumps or elsewhere as required. Provide conduits to building for monitor wiring if pumps are remotely located.
Provide adjacent to the fire alarm control panel: 110V surge protected power; one Analog cable drop per MSCS ISG Cabling Standards.

APPENDIX D - CAFETERIA AND KITCHEN DESIGN GUIDELINES

When applicable, a Kitchen Designer should be retained by the Architect and approved by MSCS to provide expert advice and design of the Kitchen. It is the responsibility of the Architect to select this consultant and coordinate his/her work with the Central Nutrition Center.

A. Docks

1. Elevated docks should be standard semi-trailer truck height.
2. Overhang should be provided for protection when unloading, but high enough to clear top of 18-wheeler. A moderate setback from the dock face is acceptable.
3. Overhang should not extend to the point that truck fumes could be trapped.
4. It is recommended that the school central receiving and cafeteria use a common unloading dock.
5. Do not allow garbage from building to go through the Kitchen to the dumpster locations.

B. Can Wash Area on Loading Dock

1. Area should have a floor drain.
2. Plumbing should include a permanent vacuum breaker and non-freeze mixing faucet.

C. Doors

1. The back door should be 48” wide with a small security glass and a doorbell to announce deliveries.
2. The storeroom door should be 42” wide.
3. All other doors in kitchen should be 36” wide.

D. Employee Restroom Facilities

1. Lockers should be full-length.
2. Number of lockers should be adequate for one per employee – see equipment list.
3. Hand sink may be in Restroom and right outside the door.
4. Restroom must have self-closing door.
5. Hand sink in Restroom should have mirror, towel dispenser, and soap dispenser.

E. Manager Office Area

1. Windows should allow for observation of both the receiving and food preparation areas while seated at the desk. Sill should be at approximately 44” AFF.
2. Space for one 5’ desk, one chair, one side chair, one legal 4-drawer file cabinet, one 5’ table, and one bookcase. (Furniture furnished by school system.)
3. Office should be wired for computer outlets.
4. Remote telephone bell should be in the kitchen area.
5. Floor should be the same as the kitchen or vinyl tile.
6. Heat/AC should be provided in the manager’s office.

F. Floors

1. Quarry tile with black grout for kitchen, serving and dish wash areas. Alternate finishes shall be considered.
2. Walk-in cooler/freezer floors shall be quarry tile at the same elevation as the kitchen floor.

G. Shelving

1. All shelving should have independent uprights. No starter/adder concept units.
2. Dry storage shelving to be epoxy coated wire. Dunnage shelving to be included in dry storage area.
3. Walk-in freezer/cooler shelving should be all stainless steel (posts, brackets, screws, etc.). Epoxy coated shelving may be used in lieu of stainless steel.
4. Wall shelves should be utilized on all available wall space in kitchen over tables and sinks. This shelving should be louvered with pot and pan rack.
5. Storage shelf width should be 24 inches – Wall shelves should be 12” –16”.

H. Walk-in units

1. Walk-in units shall be sealed to the ceiling.
2. Specify 48-inch-high stainless steel kick plate on the inside and outside of the door and on all exposed outside walls.
3. Specify 3 hinges on door.
4. Specify adequate lighting in walk-in. This should be 4’ two-bulb fluorescent fixtures (of the correct temperature rating) every 6-8 feet.
5. Ceiling to have white finish.
6. Factory installed temperature alarm system should be provided.
7. Condensate drain should run to a mechanical room or under a piece of equipment – not in an aisle.
8. Compressors may be mounted remote or adjacent to the unit (not on top). Service access is important.

Remote units must be secure. Weather control must be provided for outdoor units. Interior compressors should be sized appropriately and secured to wall mounts with adequate drains.

9. Air-cooled compressors are preferred. Make sure the cooling system is correct for the installation. Do not tie the compressor to the cooling system of the school. Do not install 480-voltcompressors.
10. Floor of walk-in units should be level with kitchen floor and of same finish material to allow for use of carts.
11. Heater strips to be placed in the threshold and frame of the door on a freezer.
12. Threshold plate should be secured to floor.
13. Single aisle width of 36 to 42 inches with 24-inch shelving on both sides.
14. Provide a 6" air space between the face of walk-in panels and adjacent walls to prevent mildew. Provide a trim panel to cover the opening where exposed to the room.

I. Hoods

1. All stainless-steel construction.
2. Automatic fire suppressant system should not be connected to a wall-mounted switch that looks like a light switch. It should be labeled as the fire suppressant pull station.
3. Use a mechanical gas valve system not an electrical system so that an interruption of electrical service will not cause the system to be activated.
4. The system shall be separate from the school's fire alarm.
5. System shall meet all applicable Codes.
6. The reset system should not be mounted in the ceiling.
7. Tanks should be mounted to the wall out of all traffic areas.
8. Hood construction should be specifically reviewed with the owner prior to bidding to ensure acceptability.

J. Under-Hood Equipment

1. Specify rear mount manifold and regulators on all gas equipment
2. Specify electronic spark ignition on all gas equipment except range tops.
3. Water should be supplied for filling and cleaning equipment under the hood (skillets, kettles, trunnions). Specify flexible hose (T&S) in lieu of fixed spigots. Flexible hoses may be used to service multiple pieces of equipment. Verify to specify vacuum-breakers for these items.
4. Flue risers on gas equipment should be all stainless steel.
5. All equipment with hoses must have vacuum breakers.
6. Utility connections under the hood should be neat and easy to clean between equipment.

K. Drain Grates

1. Grate rails should be narrow to prevent splashing. Grates should be light enough for lifting and strong enough to keep from warping under daily traffic.
2. All floor grates should be positioned so that the grate and basket can be removed for cleaning.
3. Drainage system for equipment under the hood like the tilting skillet should be positioned so that any pour off hits the drain from any angle that the equipment may be tilted.
4. Grates perpendicular to the front of the equipment accommodate tilting pour off better than parallel grates.
5. Steam equipment blow down condensates should be drained to a common drain in the rear of the equipment, not to the front drains.
6. Exposed drains should have full covers so that mobile equipment can be rolled over the drain cover.
7. Position drains so that all floor areas are easily accessible to a drain.
8. Dishroom should have several floor drains.
9. Storage room should have at least one floor drain.
10. Ice machine should have copper drain pipe with 1-1/2 inch air gap to floor drain.
11. Review drains and locations with the owner prior to bidding.
12. Do not specify enamel-coated cast iron drains, grates or covers. Specify stainless steel or brass units.

L. Tables

1. Tables should not be specified with overshelves. Use wall shelving instead.
2. When possible, tables should be located for two-sided work.
3. Pot racks should be specified on several tables. Racks should be secured to table base rather than tabletop. Pot racks to be stainless steel.
4. Undershelves on tables shall be 16-gauge stainless steel. Legs on all tables to be stainless steel.
5. Drawers should be positioned so that each side of table has access to a drawer. Drawer pans to be 20-gauge stainless steel with roller bearings and recessed built-in handles. Front of drawers to be same

finish as tabletop. Standard drawer size 15 x 20 or 20 x 20.

6. Bakers table to be sized to accommodate 3 mobile bins and a set of vertical drawers. This table must have a backsplash on the rear and both sides.
7. All corners on tables with backsplash are to have coved corners. Edges to be rolled to prevent injuries and the ends of the tables should be enclosed.

M. Sinks

1. Hand sinks should be accessible. All hand sinks to have a mixing valve. Show soap and towel dispensers over all hand sinks. Show towel dispenser so that space is not wasted (where a mirror is not required, put the towel dispenser over the sink).
2. Compartment sinks should accommodate 18 x 26 pans. Minimum compartment size should be 20 x 28. Water depth should be a maximum of 14 inches, unless there is a disposal in the sink, then the water depth may have to be adjusted to allow for height of disposal under the sink.
3. Overflow drains are not necessary in all compartment sinks if the compartment divider does not come all the way to the top of the sink. Compartment divider panels should be double thickness.
4. Specify twist waste drains on all compartments.
5. All sinks must meet NSF specifications.
6. Drain boards should be located on each end of all compartment sinks – 36-inch drain board minimum.
7. A vacuum breaker is required and must come through a tabletop, verify that a flange cover is provided. If the pipes exit on a surface with a 45-degree angle (like a backsplash top), specify a T&S B-455 unit so that the unit will be covered.

N. Hose Reels

1. Locate hose reels so that all areas of the kitchen are covered.
2. Hose reels to be enclosed type.
3. Position hose reels 60+" high on walls rather than under sinks.
4. Must be installed with vacuum breaker. Built in wall units are preferred.

O. Serving Line Area

1. The color of serving line and dining area should be coordinated with the dining room decor.
2. Height of line to be coordinated with age of child. Verify with MSCS Nutrition Services.
3. Cam lock to secure line components is better than lever locks.
4. Sneeze-guards should be designed to be easily cleaned.
5. Specify lights and heat lamps.
6. Drain hoses under serving lines should meet floor drains.
7. It is desirable for the serving line to have its electrical circuit run thru an accessible disconnect switch just inside the kitchen so that it can be shut down when not in use. The ice cream cooler and cash register should not be on this disconnect. Use load center with Serving Line

P. Electrical Information

1. Do not drop junction boxes from the ceiling for connection to equipment with exception of pass-through refrigerators and freezers.
2. Provide extra electrical outlets for additional future equipment.
3. Electrical junction boxes on floor mounts or near water sources should have NEMA 12 rating.
4. The electrical panel for the kitchen equipment should be in the kitchen.
5. Where possible, provide space and outlets for future equipment to be added.

Q. Dishwashing Area

1. The pass-through window for soiled dishes should have a minimum 5-foot-wide opening. No tray shelves are needed. The wall below the window (and adjacent trash chutes) on the dining room side should be covered with a stainless-steel panel down to the base.
2. The pass-through window should have a pull-down cover with locks. This window works better if the cover runs in channels that are fabricated as part of the dish table and its backsplash. Specify the pass-through window and rolling door to be provided by the kitchen equipment supplier.
3. Pass-thru edge should be slightly raised to prevent water from spilling onto floor on cafeteria side.
4. Window must be sealed to the wall.
5. Dish machine shall be a high-temperature machine. Stainless steel interior and exterior. Specify vent covers on both ends and all sides of the dish machine (total of 4).
6. Pant leg type exhaust hood should be specified on each end of dish machine. Hood clearance should allow for dish machine maintenance. Hood should be 20-gauge stainless steel to ceiling. All surfaces should be designed with slope so that moisture cannot accumulate inside the hood. A good design will

drain condensation to the soiled dish end of the dish machine.

7. Dirty dish table should have a 20 x 20 sink with tray glides, an in-sink disposal, and a spray hose.
8. Clean dish table to have under shelves for storage.
9. Table edges to have a backsplash with a 45-degree turn to wall – no rolled edge to wall.
10. A 24-inch-high backsplash should be installed on the dirty dish table from the return window to the dish machine.
11. Water pressure should not exceed 20 psi to the dish machine. A pressure reducing valve may be required. Water pressure on other equipment must comply with the manufacturer's specifications.
12. Avoid turns in the clean dish table. The clean dish table needs a slight pitch to allow water to flow back into the machine. The floor sink for the dish machine must be sized to accept the water when the machine is emptied. This requires a rather large capacity.
13. Wall shelves for dish racks should be 24 inches wide and sloped. Position for easy reach by employees but high enough so that shelf does not interfere with work on the dish table. Specify a drain tube and locate it where it will not drip onto clean dishes.

R. Miscellaneous

1. Fire extinguishers should be recessed in the wall.
2. Lock on doors between the dining area and the kitchen should be positioned to lock from the kitchen side. All kitchen locks should be separated from the school locks.
3. The chemical storage area should have a lock.
4. Paint used in the kitchen should be epoxy and easy to clean.
5. No more than 1/4 inch food service rated silicone caulking is acceptable in any location.
6. Locate a clock in the kitchen.

S. Commissioning

The Following Schedule Should Be Implemented When Turning Over a Kitchen Facility:

1. Kitchen should be completed four weeks before the first serving day of the facility. All equipment should be tested and completely operational.
2. Architect and Construction Office to prepare a preliminary punch list.
3. Items on preliminary punch list to be corrected before Food Service equipment demonstration.
4. Food Service Department to participate in the demonstration and training of all equipment two weeks before the opening of the facility. At this time, the following to be turned over to the Owner:
   a. Two (2) sets of operational manuals with warranties, parts list, etc.
   b. All keys.
   c. List of equipment costs for depreciation schedule and inventory.
5. Any additional problems found during the Food Service Demonstration must be corrected one week before the first serving day of the facility.

EQUIPMENT REQUIREMENT LIST

ITEM	SCHOOL SIZE (Number of Students) <400	401-600	601-900	901-1,200	1,201-1,500	COMMENTS
Convection Oven, Double	1	1	2	2	2	
Stack Convection Steamer, 2 compartment	1	1	2	2	2	Door may hinge either side; specify
Steam kettle, 40 gal.	0	0	1	1	1	W/ Water fill station
Tilting skillet, 40 gal.	1	1	1	2	2	W/ Water fill station
Range	1	1	1	1	1	

	ITEM	SCHOOL SIZE (Number of Students) <400	401-600	601-900	901-1,200	1,201-1,500	COMMENTS
Baking Area	Baker's table	1	1	2	2	2	
	Mixer, 60 qt.	0	0	0	1	1	
	Mixer, 30 qt.	1	0	0	1	1	Floor mount
	Mixer, 20 qt.	1	1	1	1	1	Bench mount
	Mixer Stand	1	1	1	1	1	
	Proofer	1	1	2	2	2	
	Open Rack	1	2	2	3	3	
Salad Area	Work table	1	2	2	2	2	
	Sink, 2 compartment	1	1	1	1	1	W/ drain boards
	Slicer, electric	1	1	1	1	1	W/ stand
	Food processor	1	1	1	1	1	W/ stand
	Garbage disposal	1	1	1	1	1	
	Wall shelves	1	1	2	2	2	
	Refrigerator, 2 section	0	1	1	1	1	
Gen. Kitchen	Work table	1	1	2	3	4	Backsplash only when against walls
	Work table w/ pot rack	2	2	2	2	2	
	Sink, 3 compartment	1	1	2	2	2	W/ drain boards
	Pot & pan mobile rack	1	1	2	2	2	Next to pot & pan sink
	Wall shelves	1	1	2	2	2	Overall sinks & tables next to walls
	Hose reel	1	1	2	2	2	Serves entire kitchen
Storage Areas	Dry storage w/ shelving	270	300	400	500	600	Square feet
	Walk-in cooler w/ shelving	100	150	175	200	225	Square feet
	Walk-in freezer w/ shelving	150	200	300	350	400	Square feet
	Non-food storage	30	30	30	30	30	
Serving Area	Pass-thru, cold, 2 section	1	1	0	0	1	
	Pass-thru, cold, 3 section	0	0	1	1	1	
	Pass-thru, hot, 2 section	1	1	1	1	2	
	Pass-thru, hot, 1 section	0	0	1	1	1	

*Size according to school population

	Ice machine	1	1	1	1	1	
	Beverage table	1	1	1	1	1	Depends on serving line
	Milk box	1	1	2	2	2	
	Tray dispenser	1	2	2	4	4	**
	Hot section	1	2	2	4	4	**
	Cold section w/ solid top	1	2	2	4	4	**
	Cashier stand	1	2	2	2	2	**

	ITEM	SCHOOL SIZE (Number of Students) <400	401-600	601-900	901-1,200	1,201-1,500	COMMENTS
Dishwash Area	Soiled dish table	1	1	1	1	1	
	Silverware chute	1	1	1	1	1	
	Silver soak sink	1	1	1	1	1	Beneath dish return window
	Pre-rinse sink	1	1	1	1	1	Built into soiled dish table
	Garbage disposal	1	1	1	1	1	In drain of pre-rinse sink
	Dishwash machine	1	1	1	1	1	Capacity according to school population
	Wall rack	1	1	1	1	1	
	Clean dish table	1	1	1	1	1	Minimum 9'; more preferred
	Hose reel	1	1	1	1	1	Serves dishwash only
	Clean dish carts	1	1	1	1	1	
Misc.	Telephone	1	1	1	1	1	In office
	Clock	1	1	1	1	1	Owner furnished, battery type
	Utility carts	2	3	4	4	5	
	Hand sinks	2	2	2	3	3	Serve all portions of kitchen
	Lockers	4	5	7	10	12	Full-length lockers

APPENDIX E - KEYING SYSTEM FOR NEW CONSTRUCTION

The following guidelines should be used in developing the keying system at the new school. Pass it along to the hardware consultant/supplier so that he can work out the plan for how the doors will be keyed. It is strongly suggested that once that plan is completed you schedule a meeting between the hardware consultant and yourself to go over it in detail while referencing it to a plan of the building.

GRAND MASTER KEYS: Opens every door in the school, will be highly restricted. Only about 2 should be produced and should be distributed as follows:

- 3 for school – Principal (for him/her, the Assistant Principal, and a spare for the cabinet)
- 3 for Security Department
- 1 for Maintenance Department
- 3 for Operations Department

CLEANING MASTER KEYS: Provide 10 – give to head custodian or Principal; opens all doors except:

- Kitchen area (define a "secure" perimeter to secure food stuffs)
- Media Center A/V Storage room (only)
- Office "records storage" room
- Any classroom closets

KITCHEN MASTER: Provide 6 – give to the Kitchen Manager only; opens all doors in the kitchen area. Provide 2 individual keys for all individual doors but give these to the manager also. The loading dock entry door to the kitchen shall be operable by the kitchen master.

MEDIA CENTER A/V STORAGE ROOM: Shall be on its own key and not on any master except the Grand Master. Provide 6 keys for these doors. They should be distributed by the Principal to his/her choice of staff persons.

OFFICE RECORDS STORAGE ROOM: Shall be on its own key and not on any master except the Grand Master. Provide 6 keys for this door. They should be distributed by the Principal to his/her choice of staff persons.

MECHANICAL MASTER: Provide 1 per door using the system master Electrical/Mechanical key for all Mechanical, Electrical, and Custodian rooms. No individual keys are therefore needed for individual doors.

ADMINISTRATION OFFICES (Principal, Assistant Principal, etc.): keys should also open the corridor doors to the area. The keys to the corridor doors do not open any additional interior doors. They should be distributed by the Principal to the corresponding staff members.

Any classrooms with storage closets shall have the room door key also operate the storage closet, but where the Custodian's key will not open the closet. If the classroom key cannot be made to do this, then key the closet independently (provide 2 keys for each) and not operable by any other key except the Grand Master. These should be in the key cabinet and issued along with the corresponding classroom key.

Individual doors not otherwise restricted are to have two keys provided for each door. They should be distributed by the Principal to the corresponding staff members.

The exterior door to the main Mechanical Room shall be keyed to the Mechanical Master Key. Provide 2 keys. These should be kept in the key cabinet if the Maintenance Department has been issued Mechanical Master Keys.

Exterior (corridors and lobby) doors shall be keyed individually with two keys each provided. They should be distributed by the Principal as needed.

Have the individual classroom keys also open the teacher's workroom doors and the teacher lounge door. If this is not possible, have sufficient copies made for all staff members to be issued one key each to the lounge and the appropriate workroom.

The contractor should be required to completely set up the key cabinet, including hanging the keys on tags in the cabinet, and the control record book. He should be required to set up the system according to the room numbering system that the school will be using and to provide a small-scale plan to correlate the numbers and the doors. The contractor should be required to provide training for the Principal on how the system works to keep records of who has been issued keys. This is in excess of what the key sub is used to doing and it must be emphasized in the contract documents as to what is being required.

If a “control key” is used in setting up and installing the lock cylinders, possession of it should be careful controlled by the contractor and then turned over to the P.M. when the installation is complete.

APPENDIX F - ARTS AND MUSIC DESIGN CONSIDERATIONS

The Art and Music rooms are defined on whether the Project is an Elementary, Middle or High School. Careful consideration of the location of these rooms is required. The Art classroom benefits from good natural light and outdoor views. The Music Room produces high noise levels.

The art classroom requires more casework than a normal classroom. A two-compartment sink at ADA height as well as a large basin sink are required. Both sinks must have plaster traps. The Art storage room and the Kiln room shall have storage shelving. The Art room will not be furnished with lockers.
The Art room shall have only one eight-foot marker board but as many tack boards as can conveniently be arranged in the space. An art room furniture package has been developed by the Art Coordinator and will come to the site as part of the IDS furniture package for the Project. This furniture will be paid for out of the regular furniture budget.

The Kiln is furnished as a part of the furniture package for the Art room. It will be a part of the furniture package. The Kiln usually requires a 208-volt, 30 amp, single phase circuit. (Check voltage etc. before design is complete) The Kiln room should be exhausted by a separately switched fan. No hood is required. Provide Air Conditioning in this space to match the CFM of the supplied exhaust fan. Under cut the door for the return of the Air Conditioning CFM when the exhaust fan is not running.

The Music classroom will be provided without lockers other than a TV cabinet and lockable teacher's wardrobe and cabinet. (A TV bracket may be used in the interest of space savings). Music storage should have wooden shelves sized for musical instrument storage. Verify shelving clearance requirements with the Music Teacher or MSCS Music Department. These shelves shall be built of plywood with hardwood edges, painted.

Consideration should be given the acoustics of the Music room and suitable acoustic panels provided as required. The space shall be of LVT or hard floor for better acoustics.

APPENDIX G - PHYSICAL EDUCATION DESIGN REQUIREMENTS

These spaces are defined whether it is an Elementary, Middle or High School space.

Middle schools require a formal gymnasium configuration with a regulation court on the main axis and cross-courts on each half of the floor. A retractable curtain should be provided to divide the gym in half for independent use of each side.
The following equipment shall be part of the construction contract:

SOUND CONTROL: Acoustical metal deck should be used as a primary measure, but additional acoustic panels on the walls are needed. “Tectum” type products do not seem to be very effective on the walls even if it is a good material for abuse resistance and should not be used.

APPENDIX H - MAINTENANCE AND OPERATIONS CONSIDERATIONS

FOR DISCUSSION ONCE PROJECT IS AWARDED.

APPENDIX I - COMMISSIONING REQUIREMENTS

SEE DIVISION 01 90 00

APPENDIX J – PREFERRED HVAC MANUFACTURERS

List below is for reference and not meant to be exclusive of any manufacturer.

Equipment	Manufacturer	Manufacturer	Manufacturer
Pumps	B&G	Grundfos	Armstrong
Boilers	Lochinvar	Patterson-Kelley	Cleaver Brooks
Cooling Towers	Reymsa	Marley	Evapco
Variable Frequency Drives	ABB	Emerson	Siemens
Plate Frame Heat Exchangers	B&G	Armstrong	Evapco
Controls	**Siemens Talon/Desigo Automation**	**JCI, Metasys**	**Trane, Tracer**
Chillers	Daikin	Carrier	Trane
Unit Ventilators/ SCUV	Daikin	Magic Aire	Trane
Roof Top Units	Lennox	Carrier	Trane
Dedicated Outdoor Air Unit	Daikin	Carrier	Trane
Split Systems DX	Daikin	Mitsubishi	Carrier
Fan Coil Units	Daikin	Carrier	Trane

APPENDIX K – SUBSTITUTION REQUEST FORM

SUBSTITUTION REQUEST FORM

Project:_____ Substitution Request Number: _____
From: _____
To: _____ Date: _____
A/E Project Number: _____
Re: _____ Contract For:_____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph:_____

Proposed Substitution:_____
Manufacturer: _____ Address:_____ Phone: _____
Trade Number: _____ Model No.:_____
Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.
Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

	Yes	No
The substitution will create an additional cost to the owner?		
The substitution will create a savings to the owner?		
The substitution is being used for cost saving purposes?		
The substitution is being used for the purpose of making installation less difficult?		
Please list additional reasons and/or a reason not shown above why this substitution is being requested.		

The Undersigned certifies:
Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
Same warranty will be furnished for proposed substitution as for specified product. Same maintenance service and source of replacement parts, as applicable, is available.
Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
Proposed substitution does not affect dimensions and functional clearances.
Payment will be made for changes to building design, including A/E design, detailing and construction costs caused by the substitution.

Submitted by: _____
Signed by: _____
Address: _____
Telephone: _____

A/E's REVIEW AND ACTION
__ Substitution Approved - Make submittals in accordance with Specification Division 01 30 00.
__Substitution Approved as Noted - Make submittals in accordance with Specification Division 01 30 00.
__Substitution Rejected - Use specified materials.
__Substitution Request Received Too Late - Use specified Materials.
Signed by:_____ Date:_____

Supporting Data Attached: 18 Drawings 18 Product Data 18 Samples 18 Tests 18 Reports 18 ___

Closeout Documents Checklist

School _____ Project _____

Contractor_____ Project Manager_____

🗂 Administrative Closeout Documents

- — **Final Application for Payment**
- — **Lien Waivers** (from subcontractors and suppliers)
- — **Certificate of Substantial Completion**
- — **Certificate of Final Completion**
- — **Punch List and Completion Verification**
- — **Change Order Summary**
- — **Contractor's Affidavit of Payment of Debts and Claims**
- — **Contractor's Affidavit of Release of Liens**
- — **Final Release of Retainage**

📐 Technical & As-Built Documentation

- — **As-Built Drawings**
- — **Record Specifications**
- — **Shop Drawings**
- — **Product Data and/or Samples**
- — **Commissioning Reports**
- — **Test & Balance, Start-up Reports, and Inspection Reports**

🛠 Operations & Maintenance (O&M) Documents

- — **O&M Manuals**
- — **Manufacturer Warranties**
- — **Maintenance Schedules**
- — **Spare Parts Lists/5% attic stock (if any)**
- — **Owner Training & System Demonstration & Documentation for Facility Staff**

Legal & Compliance Documents

- Permits and Inspection Certificates
- Environmental Reports
- Safety Records (if any)
- Insurance Certificates
- Final Building Permit Sign-Off
- Contractor's Warranties and Guarantees

Project Archives

- Project Photos
- Daily Reports
- Meeting Minutes
- Correspondence Logs
- Submittal Logs
- Digital or Electronic copies of the Closeout Docs (Thumb drive/Flash drive)



_____

Contractor's Name & Signature, Date

_____

Project Manager's Name & Signature, Date

APPENDIX M – COMPLIANCE DOCUMENTS

Compliance Checklist

The following items are due BEFORE beginning work and should be updated as needed:

☐ Employee Background/Fingerprinting & MSCS Current Year Vendor ID Badge
☐ List of Subcontractors, Suppliers, & Vendors – lien releases will be due at closeout
☐ Davis-Bacon Act Resources Received
☐ Permit issued by Memphis and Shelby County Division of Planning and Development
☐ Material loading/unloading & storage area maps
☐ Emergency Contact & Action Plan
☐ Project Safety Plan
☐ Equipment Operator Certification (when applicable)
☐ Performance Bond Document from bonding company
☐ Certificate(s) of Insurance (COIs) – (must include copies of COIs from all subcontractors)
☐ Quality Control Plan from Consultant (when applicable)
☐ Bank Information Request form

The following items must be completed throughout the project life cycle:

☐ Employee Daily Sign-In Sheet
☐ Davis-Bacon Weekly Certified Payroll Form, WH-347
☐ Pay App Review Form completed with Schedule of Values - **billing is due on the 20th – 25th of each month and must include an invoice**
☐ Active reporting from consultant (biweekly reporting required when applicable)

The following items are due at completion:

☐ Construction closeout checklist and all corresponding, applicable documents
☐ Owner Training Sign-In Sheet

Employee Background/Fingerprinting & ID Badge

Every employee who will be on the site **MUST** be listed on this page. If the assigned employees change, an updated list **MUST** be submitted to reflect the addition. All employees must complete the MSCS background screening process that includes fingerprinting. After the background checks are completed and approved, employees will be eligible to receive a vendor ID badge. **A NEW VENDOR ID BADGE MUST BE RECEIVED EVERY FISCAL YEAR (JULY 1 – JUNE 30)!**

Employee Name	Date Fingerprinted	Date Background Approved	Date Badge Received	Site Superintendent	If sub employee, list company name here
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	

Employee Fingerprinting & ID Badge Instructions for TN Contractors

In accordance with T.C.A. 49-5-413, all prime contractor and subcontractor employees who will be working on school grounds when students are present, must submit to a criminal history records check through the Tennessee Bureau of Investigation (TBI).

The prime contractor is responsible for ensuring that not only their employees, but those of the subcontractors are fingerprinted, that their background checks are approved, and that they are wearing a visible MSCS Vendor ID badge while working in a school and/or on MSCS property when students are present.

Contractors whose primary headquarters are located in Tennessee must obtain their own ORI (Originating Agency Identifier) from the TBI prior to their employees and subcontracted employees being fingerprinted. Subcontractor employees must use the prime's ORI, even if they already have their own. If your company does not already have an ORI, instructions and a Letter of Purpose template are on the following pages.

Step 1 – FINGERPRINTING - Once the prime has their ORI, their employees and subcontracted employees must follow the steps below to be fingerprinted:

- Go to https://www.identogo.com/services/live-scan-fingerprinting
- Select Tennessee from the drop down menu & click Go
- Select Digital Fingerprinting
- Select Schedule a New Appointment
- Enter the Service Code issued by TBI when you received your ORI or use Service Code 28TYHT – School Worker, Other
- Enter your company's ORI Number (this number is received from the TBI – see enclosed instructions & template)
- Click **Yes** to confirm that fingerprinting is for your company
- Check the box to agree to the terms and click Go
- Enter the Zip Code that is closest to you/your company to search for an Identogo fingerprinting office
- Click Schedule next to the location and under the date of your choice
- Select a time that will work for you and click Continue

- Click Continue to acknowledge the notices
- Complete the form (required fields are noted with a red asterisk) and click Submit
- Review your information. If it all appears correct, click **Go.**
- Choose your company's preferred method of payment to pay the fees (all fees are to be paid by the Contractor)
- Show up at the time and location selected to be fingerprinted. You **must bring a copy of your fingerprinting registration with a valid driver's license or state ID to your fingerprinting appointment.**

After fingerprinting, the TBI will review the results based on statutory criteria under T.C.A. 49-5-413. The TBI will determine if the employee/subcontracted employee is eligible to work on school grounds when children are present. If the employee/subcontracted employee is approved, the prime contractor will receive a "green light" letter; if not they will receive a "red light" letter. Issuance of a "red light" letter means that the employee/subcontracted employee is not eligible to work on school grounds when children are present and they are not eligible for a MSCS Vendor ID badge.

Step 2 – Obtaining an ID Badge - Once the employee/subcontracted employee receives a "green light" letter, they must follow the steps below to get an ID badge:

- Obtain a paper copy of the "green light" letter
- Report to the MSCS Fingerprinting & ID office between 8:00 AM – 4:00 PM Monday – Friday (the office is closed between 12:00 PM – 1:00 PM for lunch) to obtain their MSCS Vendor ID badge. The address is 160 Glenn Rogers Sr. Street. **NO APPOINTMENT REQUIRED!!**
- **Provide a paper copy of the "green light" letter and have a valid driver's license or state ID**.
- Pay for the ID badge. **The cost for a badge is $15**. They accept cash (exact change), money order, or company check. All costs for MSCS Vendor ID badges must be paid by the contractor.
- Receive your MSCS Vendor ID badge. Your photo will be taken, and an ID badge will be printed and given to you the same day.
- **WEAR YOUR MSCS ID BADGE!!** Any time you are on MSCS property you MUST wear your MSCS ID badge so that it is visible. This is how our employees know that you have successfully completed the fingerprinting process.

For technical assistance with fingerprinting/Identogo, please call them at 1-855-226-2937.

For questions/concerns regarding your background check results, please call the TBI at 1-615-744-4071.

For questions/concerns regarding these instructions, please call the SCS Fingerprinting & ID Department at 901-416-5318.

Fingerprinting & ID Badges must be done/updated annually before July 1.

Obtaining an ORI Number – for New Contractors in TN

In accordance with TN state law (T.C.A. 49-5-413), Construction Contractors with headquarters in the state of TN, who are desirous of working for Memphis-Shelby County Schools (or any other public K-12 district), must establish an ORI (Originating Agency Identifier) with the TBI (Tennessee Bureau of Investigation) to facilitate required background checks for their employees and/or any subcontracted employees. This only has to be done once. Your ORI is assigned to your company and acts as an identifier; this number should not change.

To establish an ORI number and User Agreement with the TBI, contractors must submit a "letter of purpose" (template enclosed) on their letterhead and it should contain the following information:

- Your agency's name and the type of service(s) you provide such as general contractor, electrical, HVAC, plumbing, etc.

- The appropriate T.C.A. (Tennessee Code Annotated) (49-5-413) which authorizes your organization to fingerprint prospective employees and/or volunteers and receive criminal history record information.
- Include a copy of your license issued by a state agency (E.g. Shelby County Clerk, Dept. of Education, Mental Health, DCS, or DHS).
- A copy of your contract with MSCS and a copy of your business license.
- Send the letter along with your business license and a copy of the contract with MSCS to:

Tennessee Bureau of Investigation
Biometric Services Unit – Fee Program TAPS
901 R.S. Gass Blvd.
Nashville, TN 37216
Fax number: 615-744-4657
Email: Nancy.Rizk@tn.gov
Phone: 615-744-4045

Once your letter of purpose is reviewed by the TBI, you will receive the following forms:

- User Agreement
- VECH Application
- VECH Waiver
- Agency Applicant Privacy Rights

Please email the completed User Agreement and VECH Application to Nancy.Rizk@tn.gov. Note: The VECH Waiver and Agency Applicant Privacy Rights must be completed prior to submission of fingerprints and retained by your agency.

The TBI will send the ORI number in approximately 5 days. Then the fingerprinting process can begin. Share the ORI with all you employees, so they can register for Digital Fingerprinting through IdentoGO.com (see enclosed Employee Fingerprinting & ID Badge Instructions).

Sub- contractors are NOT eligible for an ORI number. The TBI requires all sub-contractors to utilize the General Vendor/Contractor's ORI number when fingerprinting sub-contractor employees.

The ORI number you receive will be valid for all future construction projects with MSCS or any other public or private school districts in the state of TN.

Letter of Purpose - TEMPLATE

[Your Company Letterhead]

[Current Date]

Ms. Nancy Rizk
Tennessee Bureau of Investigation
Biometric Services Unit – Fee Programs TAPS
VIA EMAIL: Nancy.Rizk@tn.gov

Subject: Request for Agency ORI Number and User Agreement

Dear Ms. Rizk,

This letter serves as a formal request to establish an ORI (Originating Agency Identifier) number and User Agreement with the Tennessee Bureau of Investigation for [Your Legal Business/Agency Name].

- **Type of Agency/Business:** We are a [e.g., General Contractor, Electrical Company, HVAC Company, Plumbing Company, etc.]
- **Service Provided & Recipient:** Our agency provides [describe your services, e.g., construction project management, electrician services, HVAC services, plumbing services, etc.] to public schools.
- **Licensing/Governing Agency:** We are licensed through the [Name of your State Licensing Board, e.g., Shelby County Clerk, TN Department of Education, TN Department of Human Services, or state "None/Private Entity"]
- **Statutory Authority:** We are authorized to conduct fingerprint-based background checks pursuant to T.C.A. §§ 49-5-413 for schools.
- **Contracted Vendors/Schools:** We are a contractor working with the public school system, Memphis-Shelby County Schools. A copy of page one of our active contract is attached to this request.

Please send the required User Agreement and your approval to the attention of:

[Contact Name]
[Contact Title]
[Company Address]
[Mailing Address]
[Phone Number]
[Email Address]

Should you have any questions or require additional documentation, please do not hesitate to contact me.

Sincerely,

(Your Original Signature)

[Your Printed Name]
[Your Title]
[Company Name]

Employee Fingerprinting & ID Badge Instructions for Out-of-State Contractors

In accordance with T.C.A. 49-5-413, all prime contractor and subcontractor employees who will be working on school grounds when students are present, must submit to a criminal history records check through the Tennessee Bureau of Investigation (TBI).

The prime contractor is responsible for ensuring that not only their employees, but those of the subcontractors are fingerprinted, that their background checks are approved, and that they are wearing a visible MSCS Vendor ID badge while working in a school and/or on MSCS property when students are present.
Contractors whose primary headquarters are located outside of the state of Tennessee must use the MSCS ORI (Originating Agency Identifier) to have their employees and/or subcontracted employees fingerprinted. Criminal records for the contractor and/or subcontracted employees will be released to MSCS for review and determination. Contractor and subcontracted employees must follow the steps below to be fingerprinted:

- Go to https://www.identogo.com/services/live-scan-fingerprinting
- Select Tennessee from the drop down menu & click Go
- Select Digital Fingerprinting
- Select Schedule a New Appointment
- Enter Service Code 28TYHT – School Worker, Other
- Enter TN930880Z (all O's are zeros) for the ORI Number
- Click Yes to confirm that fingerprinting is for the Shelby Co. Board of Education
- Check the box to agree to the terms and click Go
- Enter 38112 for the Zip Code and click Go
- Click Schedule next to Memphis, TN-Glenn Rogers Sr St Shelby County Board of Education under a date that is convenient for you **Note: Fingerprints MUST be taken at 160 Glenn Rogers Sr. St. DO NOT SELECT A DIFFERENT LOCATION!!**
- Select a time that is convenient and click Continue
- Click Continue to acknowledge the notices
- Complete the form (required fields are noted with a red asterisk)
- At the bottom of the form, click Yes to provide employer information and provide what is requested – **Note: This is who will be contacted with the background check results** and then click Submit
- Review your information. If it all appears correct, click Go**.**
- Choose your company's preferred method of payment to pay the fees (all fees are to be paid by the Contractor)
- Show up on time for fingerprinting. Your employees/subcontracted employees **must bring a copy of their fingerprinting registration along with their valid driver's license or state ID to their fingerprinting appointment.**

After fingerprinting, the MSCS will review the results based on statutory criteria under T.C.A. 49-5-413 to determine if the employee/subcontracted employee is eligible to work on school grounds when children are present. If the employee/subcontracted employee is approved, they must report to the MSCS Fingerprinting & ID office to obtain their MSCS Vendor ID Badge

Step 2 – Obtaining an MSCS Vendor ID Badge - Once the employee/subcontracted employee is approved, they must follow the steps below to get an ID badge:

- Report to the MSCS Fingerprinting & ID office between 8:00 AM – 4:00 PM Monday – Friday (the office is closed between 12:00 PM – 1:00 PM for lunch) to obtain their MSCS Vendor ID badge. The address is 160 Glenn Rogers Sr. Street. **NO APPOINTMENT REQUIRED!!**
- **Present a valid driver's license or state ID**.
- Pay for the ID badge. **The cost for a badge is $15**. They accept cash (exact change), money order, or company check. All costs for MSCS Vendor ID badges must be paid by the contractor.
- Receive their MSCS Vendor ID badge. Their photo will be taken, and an ID badge will be printed and given to them the same day.

- **WEAR THEIR MSCS ID BADGE!!** Any time your employees/subcontracted employees are on MSCS property they MUST wear their MSCS ID badge so that it is visible. This is how district staff knows that they have successfully completed the fingerprinting process and are cleared to be on school property.

For technical assistance with fingerprinting/Identogo, please call them at 1-855-226-2937. For questions/concerns regarding your background check results, please call the TBI at 1-615-744-4071. For questions/concerns regarding these instructions, please call the SCS Fingerprinting & ID Department at 901-416-5318.

Fingerprinting & ID Badges must be done/updated annually before July 1.

Subcontractor & Supplier List

All subcontractors and suppliers **MUST** be listed here. Any changes should be communicated as soon as practicable by submitting an updated list. **Lien releases will be required from all subcontractors and suppliers at closeout.**

Company Name	Contact Name	Phone	Email	Sub	Supplier	Specialty Area	Description
				☐	☐		
				☐	☐		
				☐	☐		
				☐	☐		
				☐	☐		
				☐	☐		
				☐	☐		
				☐	☐		
				☐	☐		
				☐	☐		
				☐	☐		

Davis-Bacon Act Resources

Applicable to Federally funded projects ONLY!!!

The authorized company representative, who has affixed their signature on the Compliance Checklist in this document, hereby acknowledges and accepts that the project described herein requires compliance with the Davis-Bacon Act. It is understood and agreed upon that laborers working on this project will be paid no less than the local prevailing wage and fringe benefits as determined by the Wage and Hour Division of the U.S. Department of Labor. The website SAM.gov contains copies of all published wage determinations.

It is further understood and agreed that our company will complete a weekly certified payroll on the WH-347 printable form or Online Fillable WH-347 form in compliance with this Act. A copy of the certified payroll should be submitted weekly to the MSCS Major Construction Project Manager overseeing this project.

Permit

Enter your Memphis & Shelby County Permit # here: Click or tap here to enter text.

A copy of your permit must be submitted!

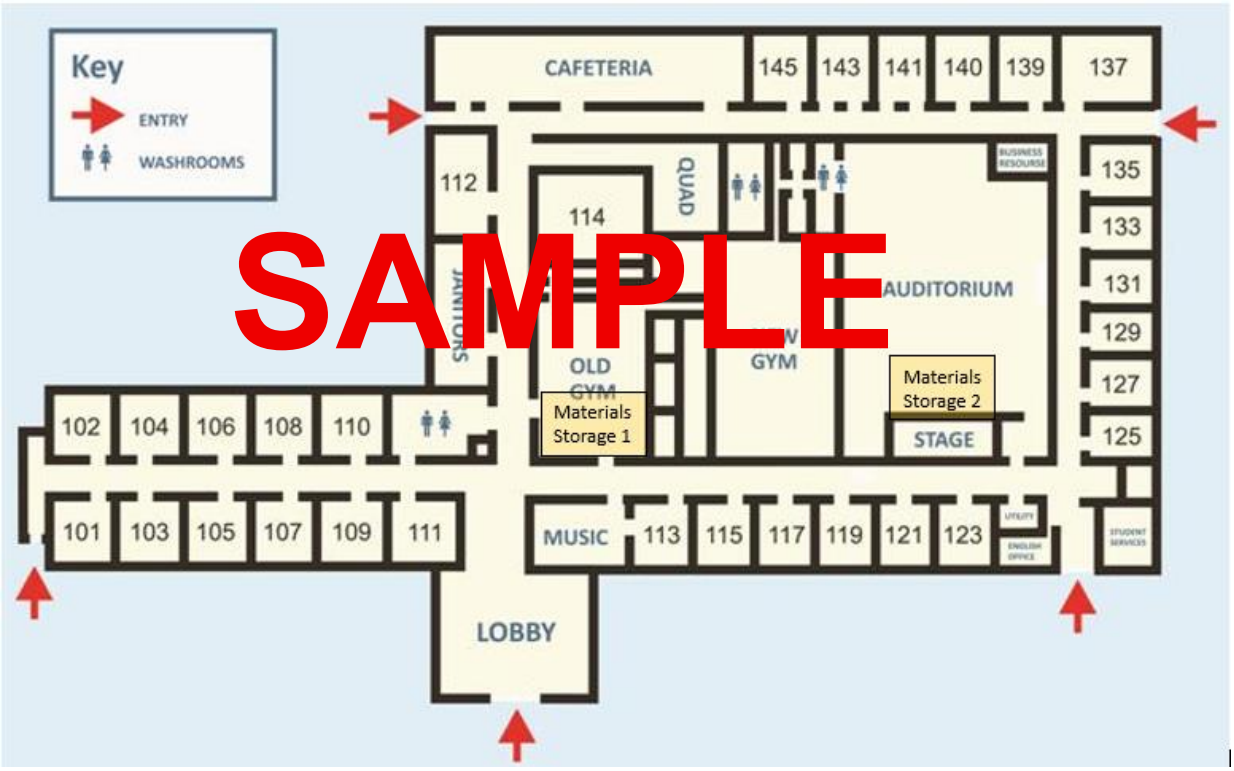
Site Map – Material Loading & Unloading Sample

Additional items that may be included on this site map are:

- Signage
- Utility Lines
- Drive Paths
- Work Areas
- Material Staging
- Entrance/Egress Locations
- Worker Parking
- Construction Equipment
- Worker/Material Handling
- Emergency Vehicle Access
- Construction Fence/Barriers
- Severe Weather & Evacuation Rally Points
- Tornado Shelter
- Temporary Restroom(s)/Wash Facilities
- Designated Safe Zones
- Waste Removal Locations



Interior Material Storage Sample (if applicable)



Emergency Contact & Action Plan

This template has been provided by the Memphis-Shelby County Schools Major Construction department as a guide to assist our contractors. Use of this template is not required. Contractors may use this template or submit their own Emergency Contact & Action Plan prior to starting a job. To use this template, complete the blue fields and select the appropriate checkboxes.

Although Name of Company takes precautions to prevent them, emergencies do occur. When they do, they require quick, correct and decisive responses. Employees have been informed of the company's planned response to emergency situations, and they are expected to adhere to these guidelines for the duration of this project.

The elements of this plan, as required by 29 CFR 1926.35, are as follows:

I. Emergency evacuation plan
II. Critical operations
III. Methods to account for Name of Company employees
IV. Rescue and medical duties
V. Means of reporting emergencies
VI. Company representative(s) responsible for plan

I. Emergency Evacuation Plan

On a typical Click or tap here to enter text. project, Name of Company will prepare a ground emergency evacuation plan

Ground evacuation procedures are as follows: Click or tap here to enter text. (Example: Exit the building from the closest emergency exit

Roof evacuation procedures are as follows (n/a if this does not apply to your project): Click or tap here to enter text.

II. Critical Operations

If any emergency occurs on a project involving propane, combustion engine equipment or electrical tools, company name employees will shut off propane sources at the cylinders and turn off all equipment before evacuating, provided employee safety is not jeopardized by doing so.

Does this project involve the use of propane?	Yes ☐	No ☐
Does this project involve the use of combustion engine equipment?	Yes ☐	No ☐
Does this project involve the use of electrical tools or other ignition sources?	Yes ☐	No ☐
Does this project involve the use of other critical operations not listed?	Yes ☐	No ☐

Explain (or n/a): Click or tap here to enter text.

If our employees are not able to shut off propane supplies, the fire department or other responding emergency agency will be notified of the presence and locations of the propane tanks.

List locations of propane on this site or “none” if not using: Click or tap here to enter text.

III. Methods to Account for Name of Company Employees

Employees have been instructed to meet at a designated location so that they can be accounted for on the project. If it is determined that any employees are missing, the responding emergency agency will be notified. The agency also will be informed about the last approximate whereabouts of missing employees.

The meeting location will be chosen based on the type of emergency involved.

The meeting location for this project will be: Click or tap here to enter text. (Example: parking lot where we park our vehicles)

IV. Rescue and Medical Duties

This crew has been specifically trained to rescue and/or attend to injured employees. Yes ☐ No ☐

If “No” has been checked, our employees will rely on paramedics or other emergency rescue teams.

If “Yes” has been checked, those employees trained in rescue operations will perform duties according to the training they have received. The remaining employees will meet at the designated meeting area.

V. Means of Reporting Emergencies

When a fire or emergency occurs, it is our intention to notify all employees, affected contractors, and building owners about the crisis.

The first call will be made to the local fire department by calling 911.

If there are 10 employees or fewer in the area, a human voice will be used to notify those on the job. For projects involving more than 10 employees, airhorns or similar equipment will be used.

VI. Means of Reporting Unanticipated Encounter with Hazardous Substances and/or Biological or Chemical Materials

If one or more of our employees unexpectedly encounters a hazardous substance, contaminated soil, and/or biological or chemical materials, work shall stop immediately and the area will be cordoned off. The job foreman/site superintendent will be notified and the MSCS Project Manager or MSCS Project Compliance Manager will be notified immediately. If there is a threat of hazardous chemical inhalation, the area and/or building will be evacuated immediately.

VII. Company Representative(s) Responsible for Plan

The job foreman/site superintendent is the responsible person to contact with any questions regarding this plan. If additional information is needed, the project manager should be contacted.

Emergency Contacts

Site Superintendent: Click or tap here to enter text.

Phone #: Click or tap here to enter text.

Other Site Contact: Click or tap here to enter text.

Police/Fire/Paramedics: **911**

Project Address: Click or tap here to enter text.

Hospital (preference): Click or tap here to enter text.

Address to Nearest Hospital from Job Site: Click or tap here to enter text.

Home Office Telephone: Click or tap here to enter text.

Project Safety Plan

This template has been provided by the Memphis-Shelby County Schools Major Construction department as a guide to assist our contractors. Use of this template is not required. Contractors may use this template or submit their own Project Safety Plan prior to starting a job. To use this template, select the appropriate checkboxes and complete the blue fields as applicable.

The purpose of the Project Safety Plan is to effectively develop a plan to address safety related issues and hazards associated with the work to be performed. Contractors must address the hazards identified with their scope of work and identify what corrective measures will be taken to effectively protect their personnel, district staff and students from hazards. The following project safety plan guidelines do not encompass all scopes of work potential hazards, and safety related requirements. Additional information may be necessary depending on the project scope.

This plan contains check boxes, and those check boxes should only be selected if the scope of work involves that item. From there, additional information should be provided as necessary and called out in this plan. If there are any questions when completing this Project Safety Plan, please contact the Memphis-Shelby County Schools Major Construction Department Project Compliance Manager.

The Contractor shall ensure that this Project Safety Plan be made available, and the contents communicated to all personnel on site at any time. This plan shall be maintained separately from other safety documentation and be kept readily available on site.

The contractor must include a project logistics plan (map/drawing) as an attachment (see sample material unloading map included). The following items shall be considered for inclusion, **please select each item that pertains to the project** and will be included:

☐ **Signage** – Include signage for temporary construction
☐ **Overhead Utility Lines** – Identify all overhead lines that may impede work or travel with equipment.
☐ **Drive Paths** – Identify the delineated drive paths with routes of movement to work locations (can be included on material unloading map).
☐ **Work Areas** – Locate on the plans the construction work areas (can be included on material storage map).
☐ **Material Staging** – Locate on plans material staging areas (see sample material storage map included).
☐ **Entrance/Egress Locations** – Identify point of entrance and exit locations to the work site(s) unobstructed with no limitations on vehicle/mobile equipment access (can be included on material unloading and/or material storage maps).
☐ **Worker Parking** – Identify on-site parking provisions, worker parking area(s) and routes to and from the work areas (can be included on material unloading map).
☐ **Construction Equipment** – Locate on plans the staging and laydown areas for construction equipment (can be included on material unloading and/or material storage maps).
☐ **Worker/Material Handling** – Identify locations and related work zones for worker/material handling equipment such as cranes and lifts (should be included on material unloading map).

☐ **Emergency Vehicle Access** – Provide emergency vehicle access and evacuation routes (can be included on material unloading map).
☐ **Construction Fence** – Locate on plans fencing and enclosure provisions (can be included on material unloading map).
☐ **Critical Utility Lines** – Identify and include on plans existing underground utility lines and temporary utility lines.
☐ **Fire Extinguisher Locations** (can be included on material storage map)
☐ **AED Location** All district locations are equipped with at least one AED machine. In most cases, an AED can be found in the hallway right outside of the main office. If the school has a gym, there may be one there as well. If your crew will have their own AED, the location can be included on material storage map
☐ **Designated Hot Work Areas**
☐ **Severe Weather Rally Point** – Locate on plans the severe weather rally point location in the event the project needs protection from severe weather (can be included on material storage map).
☐ **Evacuation Rally Point** – Locate on plans the evacuation rally point location in the event the project needs to be evacuated (can be included on material unloading map – may also be the same as worker parking).
☐ **Tornado Shelter** – Locate the tornado shelter location, if available.
☐ **Temporary Restroom(s)/Wash Facilities** – Include the plans for temporary restroom(s) and wash facilities (if required).
☐ **Designated "Safe Zone"** – Locate on plans any designated "safe zones" where work will not be performed, and PPE is not required.
☐ **Traffic Control Plan:** Include traffic control plan if applicable. Coordinate with school arrival and dismissal.
☐ **Waste Removal Locations:** Include where a permanent dumpster will be located on the project (may be included on material unloading map).
☐ **Fire Department Connection Location**

Below are General Requirements for project safety. Please indicate compliance below by selecting the appropriate check boxes.

☐ **Safety & Health Policy**
Attach a copy of the Contractor Safety and Health Policy/Safe Procedures Manual

☐ **Stop Work Authority**
All workers have the authority and obligation to stop work for any work activity or operation for which they have a concern regarding their safety and health, a fellow team member, the prevention of equipment or property damage, or a negative impact on the environment.
☐ **Incident Reporting**
All incidents regardless of perceived severity shall be reported to the assigned MSCS Project Manager or the MSCS Project Compliance Manager

☐ **Incident Investigation Review Process**

Incidents that have Significant Potential for Injury or Fatality (SPIF) will undergo a Root Cause Analysis Investigation performed by the contractor. The findings shall be shared with MSCS Project Compliance Manager as a formal review.

☐ **Environmental Plans and Procedures (mark all that apply)**

- ☐ Asbestos / hazardous materials survey reports.
- ☐ Emergency generator, boiler, or other air emissions equipment installation documentation.
- ☐ Stormwater Pollution Prevention Plans (SWPPP)
- ☐ Spill Prevention, Control, and Countermeasures (SPCC) plans
- ☐ Erosion Control Plans
- ☐ Refrigerant recovery or release documentation.
- ☐ Asbestos abatement closeout documentation
- ☐ Waste Disposal Documentation (if applicable)

The sections below are to identify the hazards specific to the project. This includes Heavy Equipment and Vehicles, Industrial Hygiene, & additional Operations

Heavy Equipment and Vehicles

☐ **Crane Safety: Project involves working with Cranes** ☐ **Not Applicable to this Project**

- ☐ Crane Lift Plan
- ☐ Critical lift planning
- ☐ Onsite Cranes – identify what cranes are anticipated to perform work onsite:
  - ☐ Articulating Cranes ☐ Crawler Cranes ☐ Floating Cranes ☐ Locomotive Cranes
  - ☐ Mobile Cranes ☐ Telehandler Winch > 1Ton Capacity ☐ Industrial Cranes ☐ Pile Drivers
  - ☐ Service/Maintenance Trucks ☐ Monorail Crane ☐ Pedestal Cranes ☐ Portal Cranes
  - ☐ Overhead Cranes ☐ Gantry Cranes (Over 1Ton Capacity) ☐ Straddle Cranes
  - ☐ Side boom Cranes
  - ☐ To Be Determined Click or tap here to enter text.

- ☐ Establish Swing Protection ☐ Working under suspended loads prohibited ☐ Utilize Tag Lines

☐ **Mobile and Heavy Equipment Safety – identify below:**

- ☐ Motor vehicles – How many company trucks and/or vans will be onsite? Enter number here
- ☐ Traffic speed **max of 10 MPH on school campus** T.C.A. 49-6-4218
- ☐ Material handling equipment
- ☐ Qualified forklift operators ☐ Forklifts
  - ☐ Make and Model of Forklifts/Telehandlers onsite: Click or tap here to enter text.
- ☐ Pile driving equipment
- ☐ Site Clearing

☐ **Mobile Elevating Work Platforms** ☐ **Not Applicable to this Project**

Industrial Hygiene

☐ **Asbestos** ☐ **Not Applicable to this Project**

- ☐ Project Specific Asbestos Survey
- ☐ Asbestos Abatement Plan
- ☐ Abatement Plan & Survey Posted at Work Location
- ☐ Abatement Subcontractor:
  Contractor Name: Click or tap here to enter text.

What is the anticipated ACM (Asbestos Containing Material): Click or tap here to enter text.

- ☐ EPA Notification Filed (10-day rule)

☐ **Cold Weather Operations** ☐ **Not Applicable to this Project**

- ☐ Team member acclimatization and protective clothing
- ☐ Warming areas will be provided for onsite personnel.
- ☐ Site preparation – a plan will be put in place to lay ice melt in work area to prevent ice slip hazards.
- ☐ Snow and ice removal plan

☐ **Global Harmonization** ☐ **Not Applicable to this Project**

- ☐ All containers of Hazardous Chemicals in their work areas are appropriately labeled.
- ☐ Labels on containers must be replaced if they are inadvertently removed or defaced.
- ☐ An SDS for each Hazardous Chemical identified on the inventory list of Hazardous Chemicals must be maintained in a manner that it is readily available to team members in the event of an emergency.

☐ **Heat Illness Prevention** ☐ **Not Applicable to this Project**

- ☐ Hydration Plan – water and other alternative hydration techniques will be utilized onsite.
- ☐ Shade Provision(s) – shade areas will be provided to personnel onsite.
- ☐ Cooling Areas – areas with air conditioning will be provided to personnel onsite.

☐ **Lead** ☐ **Not Applicable to this Project**

- ☐ Lead Content Analysis/Exposure Assessment ☐ Lead Blood Testing ☐ Lead Exposure Control Plan
- ☐ Sampling ☐ Training

☐ **Sanitation** ☐ **Not Applicable to this Project**

- ☐ Potable Water ☐ Non-Potable Water
- ☐ Number of toilets at construction jobsite: ## ☐ Washing Facilities: ## ☐ Change Rooms

Operations

☐ **Arc Flash Prevention and Protection** ☐ **Not Applicable to this Project**

- ☐ Identification of the electrical hazards associated with each task.
- ☐ A shock risk assessment ☐ An arc flash risk assessment ☐ Compliance with NFPA 70e
- ☐ Work procedures involved, special precautions, and energy source controls.

☐ **Concrete and Masonry** ☐ **Not Applicable to this Project**

- ☐ Rebar exposure - rebar will be protected by caps or other efficient means.
- ☐ Traffic patterns – concrete trucks – include routes if necessary for traffic impacts as a part of the site logistic plan. May be included on materials storage map. Must coordinate with school arrival & dismissal.
- ☐ Concrete Finishing Hand Tools ☐ Saline Eyewash on site ☐ Barrier Cream available

☐ **Confined Space** ☐ **Not Applicable to this Project**

- ☐ Confined Space Competent Person: Name of Person
- ☐ Non-Permit Spaces ☐ Permit Required Confined Spaces
- ☐ Reclassified Entry ☐ Alternate Entry ☐ Non-Permit Entry ☐ Permit Entry
- ☐ Identification of spaces by competent person – label known spaces
- ☐ Site confined space information – maintain a list of spaces, programs, forms, owner/host information.
- ☐ Team member training – available upon request
- ☐ Continuous Air Monitoring (REQUIRED) ☐ Early warning system (Engulfment Hazard)
- ☐ Rescue equipment/service – ☐ Tripod/Winch ☐ Davit Arm ☐ Entry Rescue
- ☐ List any known hazards that are anticipated to enter the space:
  - ☐ Atmospheric Hazards: Click or tap here to enter text.
  - ☐ Physical Hazards: Click or tap here to enter text.
  - ☐ Biological Hazards: Click or tap here to enter text.
  - ☐ Configuration Hazards: Click or tap here to enter text.

☐ **Demolition** ☐ **Not Applicable to this Project**

- ☐ Pre-demolition survey/Demolition plan ☐ Impairment of Life Safety Systems (impairment Plan)
- ☐ Verified Utilities Disconnected
- ☐ Selective demolition explosives ☐ EPA required permit (10-day rule)
- ☐ Environmental Monitoring Data (Air Quality)

Note: Contact MSCS Major Construction Project Manager or Project Compliance Manager in the event an unanticipated biological or chemical material is encountered.

☐ **Energy Isolation (Lock-Out Tag-Out Try-Out)** ☐ **Not Applicable to this Project**

- ☐ Recognition of applicable hazardous Energy Sources: Click or tap here to enter text.
- ☐ Type and magnitude of the energy in the workplace: Click or tap here to enter text.
- ☐ Methods and means necessary for shutting down the Energy Sources and applying the Energy Isolation and control.
- ☐ Documented Energy Isolation Procedures (no need to include in plan yet available upon request)

☐ **Excavation and Trenching** ☐ **Not Applicable to this Project**

- ☐ Excavation and Trenching Competent Person: Click or tap here to enter text.
- ☐ Hazardous Soils Assessment
- ☐ Hazardous Soils and Required Emergency Rescue equipment.
  - ☐ 4 Gas Air Monitor used for atmospheric sampling: Click or tap here to enter text.
  - ☐ Rescue equipment/service – ☐ Tripod/Winch ☐ Davit Arm ☐ Entry Rescue

☐ Protective Systems Tabulated Data available
☐ Appropriate Dig Permit obtained
☐ 811 contacted
☐ Shelby County Health Department (for soil boring)
☐ Shelby County Office of Construction Code Enforcement
☐ Protective Systems
☐ Sloping – what slope will the trench be excavated. ☐ Benching
☐ Trench Box – Tabulated Data available upon request
☐ Stay-In-Place (SIP)☐ Hydraulic Shores – Tabulated Data available upon request.
☐ Slide Rail
☐ Premium Access for Excavation and Trenches – no lateral travel without access greater than 25 feet.
☐ Accumulation of water in excavations – control methods: Click or tap here to enter text.
☐ Soil classification
☐ Stable Rock ☐ Class A ☐ Class B ☐ Class C

☐ **Fall Prevention and Protection** ☐ **Not Applicable to this Project**
☐ Fall Prevention and Protection; Competent Person: Click or tap here to enter text.
☐Guardrails, handrails, and covers. ☐ Exposure(s) over six feet
☐ Leading edge exposure ☐ Unprotected sides and edges
☐ Hoist areas ☐ Holes, floor and wall opening.
☐ Ramps and walkways ☐ Protection from falling objects.
☐ Fall protection systems on roofs over six feet
☐ Fall protection systems – standard fall protection.
☐ safety harness, ☐ retracts, ☐ lanyards, ☐ lifelines and/or ☐ other: State Here
☐ Design and testing for in-house system
☐ Rescue Plan
☐ Self-Rescue ☐ Aerial Lift/Scissor Lift ☐ Ladders ☐ Fall Rescue Equipment/Devices
☐ Fall Protection will be properly stored when not in use (i.e. tool boxes, office trailers, etc.) not exposed to weather elements.

☐ **Fire Protection and Prevention** ☐ **Not Applicable to this Project**
☐ Pre-Work Hazard Analysis
☐Fire protection –
☐ Fire extinguishers ☐ Fire watch
☐ Temporary heating devices
☐ Hot work monitored; Competent Person: Click or tap here to enter text.

☐ **Hand and Power Tools** ☐ **Not Applicable to this Project**
☐ Standard hand tools ☐ Power-operated hand tools ☐ Powder actuated tools (training and license)
☐ Abrasive wheels and tools ☐ Woodworking tools ☐ Jacks – lever and ratchet screw and hydraulic
☐ Air Compressor ☐ HILTI Epoxy and Mechanical Anchor Training

☐ **Hot Work - Welding/Cutting/Grinding/Heating** ☐ **Not Applicable to this Project**

- ☐ Hot work monitored; Competent Person: Click or tap here to enter text.
- ☐ Gas welding and cutting ☐ Arc welding and cutting ☐ Fire prevention regarding welding.
- ☐ Ventilation – local exhaust and/or fume extractor ☐ Welding, cutting, and heating in way of preservative coatings – galvanized.
- ☐ Storage of oxygen, acetylene cylinders.
  - ☐ Storage of oxygen, acetylene cylinders further than 20 feet apart whenever not in use
  - ☐ Storage of oxygen, acetylene cylinders in approved carts.
- ☐ Impact to Building Systems (Smoke Alarm, Fire Alarm, etc.)
- ☐ PPE – Clothing – Fire retardant, eye, ear, etc.

☐ **Housekeeping and Material Storage**

- ☐ Trash containers/dumpsters ☐ Recyclable materials containers/area/collection.

☐ **Illumination** ☐ **Not Applicable to this Project**

- ☐ Construction areas ☐ Entry/Egress ☐ Ramps ☐ Corridors ☐ Storage areas

☐ **Ladders / Stairways / Ramps** ☐ **Not Applicable to this Project**

- ☐ Access
  - ☐ A stairway or ladder is provided at all points of access where there is a break in elevation of 19” or more, and no ramp, runway, sloped embankment, or personnel hoist
- ☐ Guardrails ☐ Office, tool trailers, landing and steps ☐ Stairways
- ☐ Ladders (electrical exposure) wood, metal, fiberglass
- ☐ Fixed ladders
  - ☐ Greater than or equal to 6 feet high – fall protection required

☐ **Manual Material Handling** ☐ **Not Applicable to this Project**

- ☐ Personnel will be required to manually handle material.
- ☐ Team/Partner lifts for material over 50lbs

☐ **Personal Protective Equipment** ☐ **Not Applicable to this Project**

- ☐ **Standard PPE: Hardhat, Safety Glasses, Gloves, High Visibility Clothing, Work Pants, Work Boots. Hearing protection when necessary - REQUIRED**
- ☐ Respiratory Protection Devices
  - ☐ Half Face ☐ Full Face ☐ PAPR ☐ Supplied Air ☐ SCBA ☐ Medical clearance/fit testing
  - ☐ Cartridges and filters (Based on contaminants)
- ☐ Tyvek Suits

☐ **Rigging and Lifting Operations** ☐ **Not Applicable to this Project**

- ☐ Chain Falls ☐ Roust-a-bouts ☐ Excavator ☐ Crane
- ☐ All rigging will be inspected prior to use to ensure it will not be loaded in excess of its recommended safe working load
- ☐ All wire rope and chains will maintain a capacity tag

☐ Shakeout Hooks ☐ All hooks will have self-closing latches
☐ Standing under suspended load strictly prohibited
☐ Any damaged rigging will be immediately removed from service
☐ Rigging will be properly stored when not in use (i.e. toolboxes, office trailers, etc.) not exposed to weather elements
☐ Tag Lines will be utilized on overhead loads

☐ **Scaffolding** ☐ **Not Applicable to this Project**
☐ Scaffolding Competent Person: Click or tap here to enter text.
This person will be responsible for inspecting the scaffold pre shift per 1926.451(f)(3)
☐ System Scaffold ☐ Rolling/Mobile Scaffold ☐ Stair towers ☐ Suspension Scaffolds
☐ Fall protection for erection and dismantling. ☐ Scaffold tagging system

☐ **Signs / Signals and Barricades** ☐ **Not Applicable to this Project**
☐ Accident prevention signs and tags ☐ Barricades

☐ **Steel Erection** ☐ **Not Applicable to this Project**
☐ Steel Erection Competent Person: Click or tap here to enter text.
☐ Flooring requirements ☐ Structural steel assembly
☐ Fall protection required above six feet

☐ **Traffic Control** ☐ **Not Applicable to this Project**
☐ Traffic Control Plans - must be approved by School Principal or other School Administrator
☐ Equipment Delivery Traffic Control
☐ Secure a location that is at least 15' from the edge of a traveled way or behind a barrier
☐ Stockpiles of materials are located 30' from the edge of a traveled roadway or protected by a positive barrier.
☐ Traffic Control Devices
☐ Signs ☐ Barricades ☐ Retro-reflective/illumination

☐ **Utility Strike Prevention** ☐ **Not Applicable to this Project**
☐ Utility Strike Prevention Competent Person: Click or tap here to enter text.
☐ Contact 811
☐ Shelby County Code Enforcement or Health Department Dig Permit Process (REQUIRED)
☐ Overhead Utility Warning Signs
☐ Significant Underground Utilities
☐ Gas Main ☐ Water Main ☐ Power Main ☐ Storm/Sewer Main ☐ Communication
☐ Critical Utility on Project
☐ High Impact Planning Meeting Required
☐ Documented Utility Strike Prevention Plan
☐ Gas Main ☐ Water Main ☐ Power Main ☐ Storm/Sewer Main ☐ Communication
☐ Non-Destructive Means of Locating Utility
☐ Hydro excavating ☐ Hand Digging ☐ Air Knife

Heavy Equipment Operators

☐ Select this box if this project does not require the use of heavy equipment.

Employee Name	Type of Heavy Equipment	Certification/License #	Certification/License Expiration Date

Performance Bond Information

A copy of the performance bond must be submitted with this form.

Bond #: Click or tap here to enter text.

Name of Surety Company: Click or tap here to enter text.

Bond Amount: $Click or tap here to enter text.

Effective Date of Bond: Click or tap to enter a date.

Insurance Requirements

The requirements are per the contract. **A Certificate of Insurance (COI) must be submitted**. The **coverage amounts listed on your COI must meet or exceed the requirements outlined in the contract**.

Daily Employee Sign-In Sheet

Employees must sign in/out every day and the sign in/out should be available on site to review at any time. Contractors may use their own sign in/out sheet if the same information is captured.

	Sunday		Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		
Employee Name	**Time In**	**Time Out**	**Time In**	**Time Out**	**Time In**	**Time Out**	**Time In**	**Time Out**	**Time In**	**Time Out**	**Time In**	**Time Out**	**Time In**	**Time Out**	**Hours Worked**

Pay Application Review Form

Pay App #:		**Performance Bond:**	$
Date Received:		**Alternates:**	$
Total Contract Amount:	$	**Allowances:**	$
Construction Base Bid:	$	**Owner's Contingency:**	$

This document is confirmation the Department of Major Construction has reviewed the referenced pay application and is issuing the document to the authorizing agent to use at their discretion in their approval and issuance of payment to the vendor. This document will be discussed at the pre-construction meeting with the contractor.

Item No.	Description of Work	Scheduled Value	Requested This Period	Supported This Period	Difference	PM Comments
1		$0.00	$0.00	$0.00	$0.00	
2		$0.00	$0.00	$0.00	$0.00	
3		$0.00	$0.00	$0.00	$0.00	
4		$0.00	$0.00	$0.00	$0.00	
5		$0.00	$0.00	$0.00	$0.00	
6		$0.00	$0.00	$0.00	$0.00	
7		$0.00	$0.00	$0.00	$0.00	
8		$0.00	$0.00	$0.00	$0.00	
9		$0.00	$0.00	$0.00	$0.00	
10		$0.00	$0.00	$0.00	$0.00	

Consultant Bi-Weekly Active Reporting Schedule

(When Applicable)

WEEK	DATE DUE	Bi-Weekly Active Report emailed date to your Project Manager	Status	1st email request date
Bi-Weekly 1				
Bi-Weekly 2				
Bi-Weekly 3				
Bi-Weekly 4				
Bi-Weekly 5				
Bi-Weekly 6				
Bi-Weekly 7				
Bi-Weekly 8				
Bi-Weekly 9				
Bi-Weekly 10				

Owner Training Sign-In Sheet

This sign-in sheet should be used to document owner training prior to project close-out.

Instructor: _____ **Date of Training:** _____ **Time of Training:** _____

ATTENDEES

	NAME	NAME OF COMPANY	E-MAIL ADDRESS	TELEPHONE NUMBER
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				

MSCS Major Construction
Bank Information Request

Company Name		Project Name	
Company Contact Name		Project Location	
Company Contact Email		Project Start Date	
Company Address		Substantial Completion	
Contact Phone Number		Contract End Date	
Project Manager		Contract #	
Project Manager Contact		PO#	

Bank Name	
Bank Contact Name	
Bank Address	
City, State, Zip Code	
Bank Phone	
Bank Contact Email Address	

NOTE: The MSCS Accounting Department will contact your company to set up the retainage account after this form has been returned. DO NOT SEND THIS FORM TO YOUR BANK.