Davey Lopes Recreation Center

Providence, RI

Technical Specifications

Prepared for:

City of Providence

25 Dorance Street
Providence, RI 02903

Architect:
Bargmann Hendrie + Archetype, Inc.
Boston, MA

MEP/FP Consultant:
Allied Consulting Engineering, Inc.
Westford, MA 01866

Structural Engineer:
RSE Associates Inc.
Watertown, MA

Civil Engineer:
CDW Consultants, Inc.
Framingham, MA

April 18, 2025

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DOCUMENT 000110 - TABLE OF CONTENTS -TECHNICAL SPECIFICATIONS

DIVISION 28 — ELECTRONIC SAFETY AND SECURITY

DIVISION 31— EARTHWORK

DIVISION 32- SITE IMPROVEMENTS

DIVISION 33- UTILITIES

END OF DOCUMENT 00 01 10

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Project information.
2. Work covered by Contract Documents.
3. Work performed by Owner.
4. Work under Owner's separate contracts.
5. Future work not part of this Project.
6. Contractor's use of site and premises.
7. Coordination with occupants.
8. Work restrictions.
9. Specification and Drawing conventions.
10. Miscellaneous provisions.

B. Work of the Project requires coordinating construction activities during the 2025 summer camp season, including portions of the building, pool, gymnasium and portions of the site.

C. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 PROJECT INFORMATION

A. Project Identification: Davey Lopes Recreation Center

1. Project Location: 227 Dudley Street, Providence, RI 02970

B. Owner: City of Providence, Public Properties Division

C. Owner’s Project Manager: Downes Construction, Warwick, RI

D. Architect: Bargmann Hendrie + Archetype, Inc. Boston, MA

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Project makes spatial, mechanical, electrical, life safety, and building envelope improvements to the existing Davey Lopes Recreation Center. This includes, but is not limited to::
   1. Reconfigured toilet rooms including gender neutral facilities
   2. Creating single use computer rooms for remote learning and interviews
   3. Converting the former indoor pool/boxing space into a multi-purpose room
   4. Improving the existing computer learning space
   5. Improving support spaces
   6. Upgrading interior finishes at the public areas of the building
   7. Miscellaneous exterior improvements to the entry including providing accessibility
   8. New exterior windows, doors, and louvers
   9. New roofing including insulation, metal flashing, and roof drainage assemblies.
   10. Masonry repairs
   11. Upgraded electrical and tel-data distribution
   12. Fully addressable fire-alarm system
   13. Automatic fire-sprinkler system
   14. Improved plumbing and storm-drainage systems.

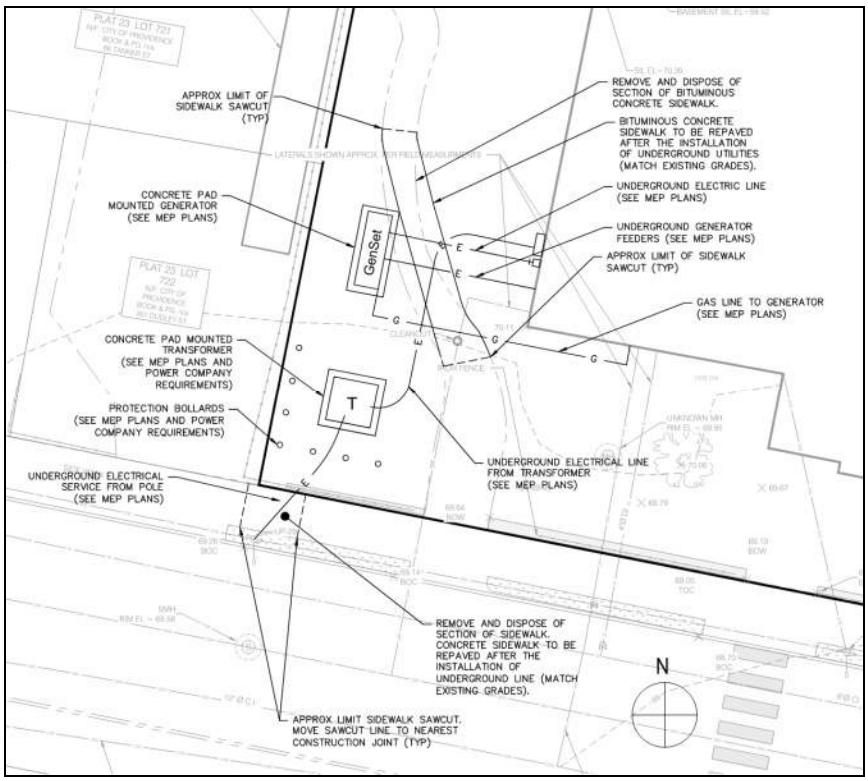
B. Type of Contract:
   1. Project will be constructed under a single prime contract.

1.5 WORK UNDER OWNER'S SEPARATE CONTRACTS

A. Work with Separate Contractors: Cooperate fully with Owner's separate contractors, so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under Owner's separate contracts.

B. Concurrent Work: Owner **has awarded** a separate contract for the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.

   1. **Davey Lopes Recreation Center Generator and Main Switch Gear. Scope includes**
   2. New electric transformer, underground duct banks, new meter, connections to existing panels in filtration room.
   3. New pad mounted stand-by generator, duct banks, new exterior automatic transfer switch (ATS).
   4. New underground gas supply from filtration room to generator
   5. Related sitework.



6. Location of New Transformer, Generator and Underground work.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

A. Limits on Use of Site: Limit use of Project site to **Work in areas** indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits on Use of Site:
   a. Period 1: Owner’s use of the building between June 23, 2025 and August 15, 2025 limits the contractor’s use of the building and site.
   b. Period 2: August 18, 2025 through Substantial Completion, Contractor shall have full use of the building and site within the contract limits indicated.

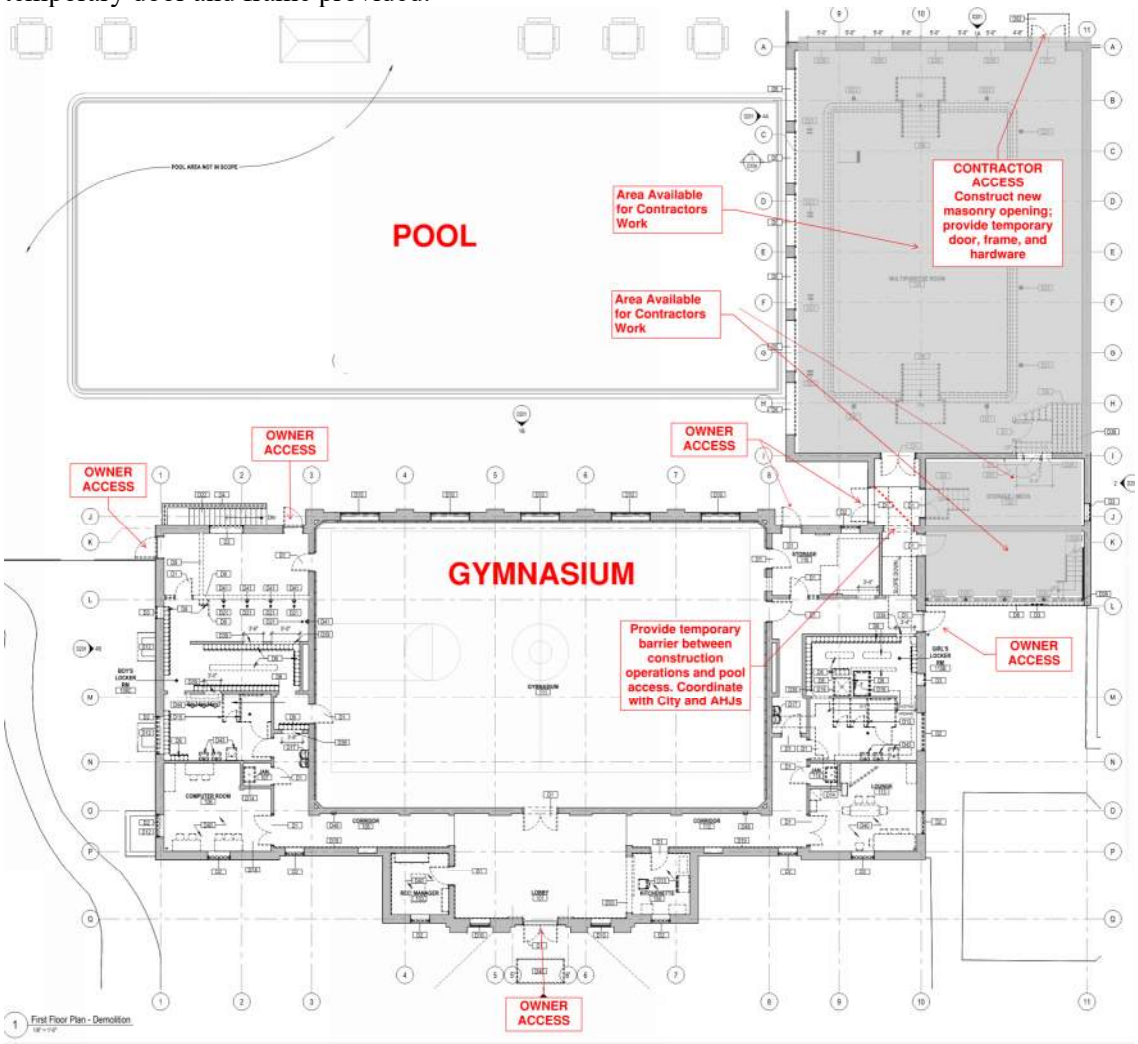
1.7 PERIOD 1 RESTRICTIONS -ENABLING WORK

A. The City will be holding summer camp at the building this summer from July 1- to August 15, 2025.

B. Contractor shall have access to the Multi-Purpose Room 124, Storage/Mechanical 123, Proposed Corridor 118 and Zoom Rooms, and mezzanine.

C. Contractor shall maintain access from the Boys’ and Girls’ Locker Rooms to the Pool area.
1. Coordinate separation of Construction access and bathers in corridor 126 with City and Authorities having Jurisdiction.

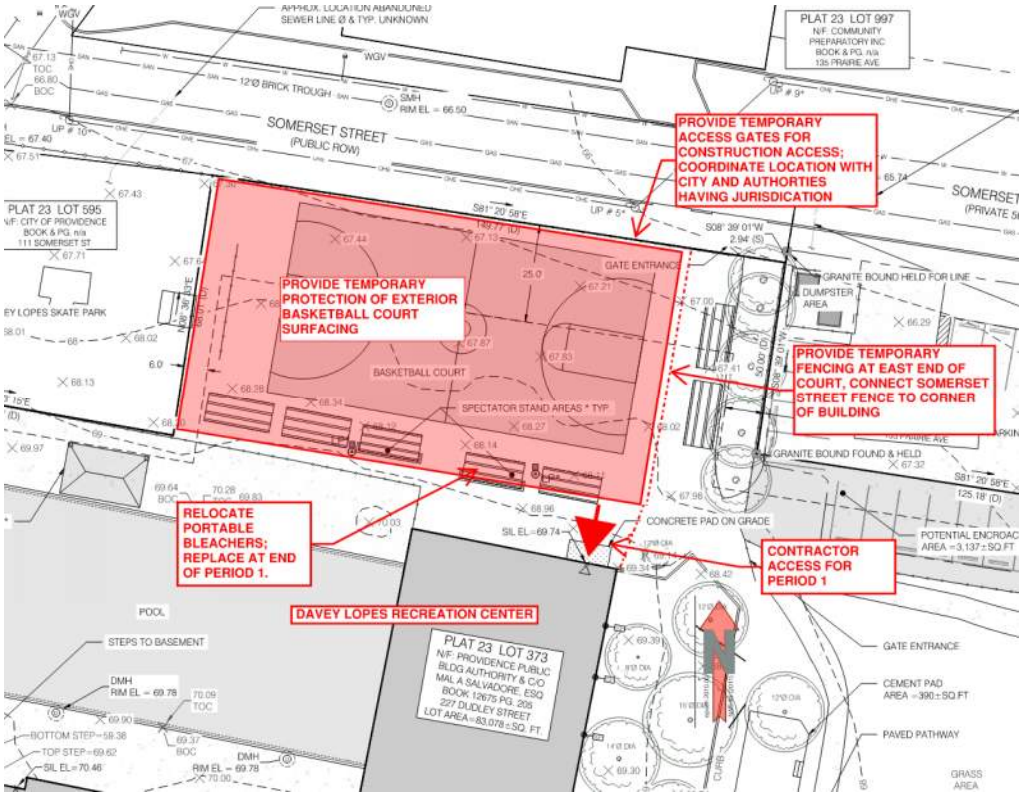
D. Contractor shall stage from the existing exterior basketball court and access the building through the new masonry opening for proposed door 124B. Opening shall be constructed and temporary door and frame provided.



Period 1 Building Access

E. Existing Basketball Court

1. Provide temporary fence opening for construction along Somerset Street. Coordinate location with City and Authorities Having Jursidications. Provide signage and barricades to protect pedestrians from construction vehicles.
2. Secure existing fence gates into basketball court
3. Provide temporary fencing along east edge of court to building to create secure enclosure.
4. Relocate portable bleachers to provide space for construction activities.
5. Restore fencing at completion of Period 1.
6. Restore damaged hardscape surfaces including basketball court.



Period 1 Site Access

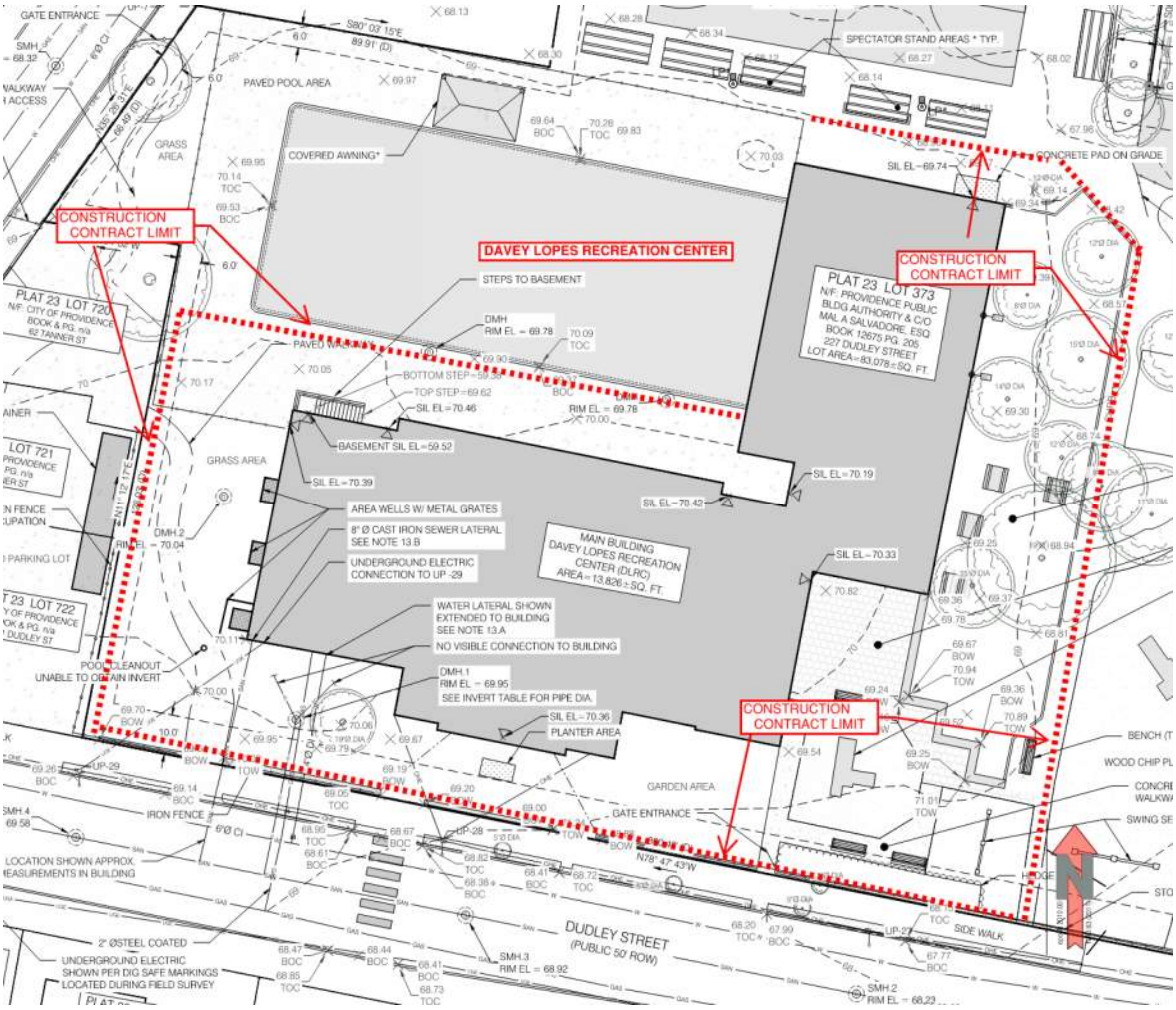
1.8 PERIOD 2 WORK RESTRICTIONS

A. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

B. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated by the Contract limits and as indicated by requirements of this Section.
   1. Do not disturb portions of Project site beyond areas in which the Work is indicated.
   2. Walkways and Park: Public walks and adjacent park spaces, including the playground and basketball court, available to the public at all times. Do not use these areas for parking or for storage of materials.
      a. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Coordinate full access within the Contract limits with the Contractor providing the new generator and electric service entrance.

D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.



Period 2 Contract Limits

1.9 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during Period 1, summer of 2025, with the exception of areas described above. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than [72] seventy-two hours' notice to Owner of activities that will affect Owner's operations.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1.10 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.
   1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
   2. Comply with Period 1 and Period 2 requirements described in this Section.

B. On-Site Work Hours: Limit work to between 7 a.m. to 5 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
   1. Weekend Hours: With advanced approval by Owner and authorities having jurisdiction.
   2. Early Morning Hours: Acceptable for non-noise generating activities inside of the existing building. Otherwise, With advanced approval by Owner and authorities having jurisdiction.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

   1. Notify Owner not less than five (5) days in advance of proposed utility interruptions.

D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruptions.

E. Smoking and Controlled Substance Restrictions: Use of tobacco products and other controlled substances on Owner's property is not permitted.

1.11 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

   1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
   2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
   3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
   4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.
3. Keynoting: Materials and products are identified by reference keynotes.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:
   1. Lump-sum allowances.

C. Related Requirements:
   1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.5 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include freight, delivery, and off-loading at the Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. 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.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Lump-Sum Allowance: Include the sum of $3,000.00 for an exterior free standing dedication plaque in front of the building. Refer to Section 101416 Plaques for general description and mounting requirements.

B. Allowance No. 2: Lump-Sum Allowance; Include the sum of $10,000.00 for providing planting material and raised bed structures.

END OF SECTION 012100

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:
   1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

   1. Substitution Request Form: Use facsimile of form provided in Project Manual.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

      a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
      b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section.

Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with International Building Code (IBC) in effect for the Project.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within **seven** (7) days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within seven (7) days of receipt of request, or five (5) days of receipt of additional information or documentation, whichever is later.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than fifteen (15) days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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Advancement of Construction Technology

SUBSTITUTION REQUEST

(After the Bidding Phase)

Project: Davey Lopes Recreation Center
Providence, RI

To: Bargmann Hendrie + Archetype, Inc.
9 Channel Center St. Suite 300, Boston, MA

Re: _____

Substitution Request Number: _____

From: _____

Date: _____

A/E Project Number: 3524

Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

☐ Point-by-point comparative data attached - REQUIRED BY A/E

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

SUBSTITUTION REQUEST
(Continued)

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.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- 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.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01330.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ _____

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions (ASI) authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on in the form of a BH+A Bulletin.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications. Proposal requests will be issued in the form of a BH+A Bulletin.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within fourteen (14) days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.

d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to the Architect and simultaneously to the Owner's Project Manager.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on a BH+A form similar to AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on BH+A Bulletin Form similar to the AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:
   1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
   1. Submit the schedule of values to Architect at earliest possible date, but no later than seven (7) days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

   1. Identification: Include the following Project identification on the schedule of values:

      a. Project name and location.
      b. Name of Architect.
      c. Architect's Project number.
      d. Contractor's name and address.
      e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703).

3. Schedule of Values shall breakout Work in each phase of the Project.

4. The Schedule of Values shall breakout work associated with abatement and removal of existing waterline that runs between Fairbank Road and Hudson Road. Breakout shall include:
   a. Excavation
   b. Abatement
   c. Removal
   d. Disposal
   e. Backfill

5. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide a line item for each specification Section. The minimum breakdown shall be:
   a. Bonds
   b. Insurance
   c. Permits
   d. General Conditions
   e. OH&P
   f. Mobilization
   g. Closeout Documents
   h. Start-up
   i. Training
   j. As-built Drawings
   k. Warranty
   l. Environmental Protection
   m. Site Protection
   n. Hazardous material removal
      1) Submittals and Notifications
      2) Mobilization
      3) Abatement and Removal by Type and Location
      4) Disposal
      5) Submission of Manifests
   o. Commissioning
6. Selective Building Demolition
7. Concrete
   a. Breakout by Area or Element
      1) Formwork
      2) Reinforcing Steel
      3) Concrete
   b. Footings and Foundations
   c. Slabs on Grade
   d. Concrete Pads
   e. Exterior egress pads
   f. Site concrete
   g. Miscellaneous Concrete
8. Masonry
   a. Masonry Demolition and Repair
   b. Concrete Masonry Units Material

1) CMU
2) Clay Brick Masonry
3) Reinforcing
4) Mortar & Grout

9. Metals
   a. Structural Steel
      1) Shop Drawings
      2) Breakout by Sequence of Erection
         a) Material
         b) Labor
   b. Miscellaneous and Ornamental Steel
      1) Submittals and Shop Drawings
      2) Lintels
      3) Handrails
      4) Gratings
      5) Elevator
      6) Miscellaneous
10. Wood, Plastics & Composites
   a. Rough Carpentry
   b. Finish Carpentry
   c. Interior Architectural Woodwork
   d. Plastic Laminate Clad Cabinets
11. Thermal and Moisture Protection
   a. Rigid Insulation
   b. Batt Insulation
   c. Air Barrier Membranes
   d. Metal Wall Panels
   e. TPO Membrane Roofing
   f. Sheet Metal Roofing
   g. Roof Accessories
   h. Sheet Metal
      1) Gutters
      2) Downspouts
      3) Flashings
   i. Fire Stopping
   j. Sealants
12. Openings
   a. Hollow Metal Doors & Frames
      1) Doors
      2) Frames
      3) Borrowed Lites
13. Bronze Doors
   a. Doors
   b. Frames
14. Access Panels
15. Polymer Windows
16. Overhead Counter Doors
17. Door Hardware
18. Glass & Glazing
   a. Insulating Glass Units

b. Interior Glass Units
c. Glass
d. Mirrors

19. Louvers
20. Light Gage Metal Framing
21. Gypsum Wall Board
    a. GWB Ceilings
    b. Acoustic Insulation and Sealant
22. Ceramic Tile (Breakdown further by type)
23. Acoustical Tile Ceiling (Breakdown further by type)
24. Resilient Flooring (Breakdown further by type
25. Painting
26. Signage
    a. Interior
    b. Exterior
27. Toilet Compartments
28. Toilet Accessories
29. Fire Protection Specialties
30. Exterior Acoustical Screens
31. Plastic Lockers
32. Solid Surface Countertops
33. Entrance Floor Mats
34. Fire Protection
    a. Engineering
    b. Rough-In Material
    c. Rough-In Install
    d. Testing
35. Plumbing
    a. Rough-In Material
    b. Rough-In Install
    c. Fixtures Material
    d. Fixtures Install
    e. Testing
    f. Start-up and Training
36. HVAC
    a. Fans
    b. Heat Pumps
    c. Ductwork
    d. Piping
    e. Controls
    f. Unit heaters
    g. Controls
    h. Balancing
    i. Testing
    j. Start-up and Training
37. Electrical
    a. Distribution Rough-In Material
    b. Distribution Rough-In Install
    c. Devices Equipment
    d. Devices Install

e. Light Fixtures Material
f. Light Fixtures Install
g. Fire Alarm Equipment
h. Tel/Data Distribution
i. Video Distribution
j. Security Distribution
k. Testing

38. Demolition of Site Elements
39. Subgrade Preparation
40. Utility Excavation
41. Miscellaneous Excavation
42. Building Backfill
43. Utility Backfill
44. Miscellaneous Backfill
45. Site Utilities
    a. Structures Material
    b. Structures Install
    c. Piping Material
    d. Piping Install
46. Concrete Paving
    a. Walks
47. Bituminous Paving
    a. Porous
    b. Regular
48. Site Improvements
49. Fencing
50. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
51. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in a minimum amount totaling five (5) percent of the Contract Sum and subcontract amount.
52. Sustainable Submittals

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

1. Submit a draft copy of the Application for Payment seven (7) days prior to due date for review by Architect.

2. Applications shall reflect work complete at time of draft submission; amounts requested shall not project work to the last day of the month.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703, or form in similar format, as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit (6) six signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment .

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. Owner reserves the right to designate which entities involved in the Work must submit waivers.
3. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner and recognized in the Commonwealth of Massachusetts.
5. Waiver Forms shall:

a. Indicate period of payment
b. Must be signed
c. Must be notarized and dated

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Sustainable design action plans, including preliminary project materials cost data.
7. Schedule of unit prices.
8. Submittal schedule (preliminary if not final).
9. List of Contractor's staff assignments.
10. List of Contractor's principal consultants.
11. Copies of building permits.
12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
13. Initial progress report.
14. Report of preconstruction conference.
15. Certificates of insurance and insurance policies.
16. Performance and payment bonds.
17. Data needed to acquire Owner's insurance.

I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706.
5. AIA Document G706A.
6. AIA Document G707.
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:
1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. OPM: Owner’s Project Manager

C. RFI: Request for Information. Request from Owner, OPM, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 NAMING CONVENTIONS

A. All documents and forms shall be clearly labelled and numbered as follows:
1. Emails: Subject Lines of Emails shall start with “DLRC”
2. Documents: All forms shall contain “Davey Lopes Recreation Center” or DLRC in the file name.

3. All RFI's shall contain a subject line to describe the RFI
4. All Submittals shall contain the Specification Number and Title of the submittal.

1.5 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within fifteen (15) days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities, list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory. Keep list current.

1.6 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.

5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.7 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

   a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
   b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
   c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
   e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
   f. Indicate required installation sequences.
   g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
   h. All filed subtrade subcontractors shall coordinate all underground locations with GC prior to final backfill prep for slab.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate sub framing for support of ceiling, and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts, and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

6. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.

7. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will inform Contractor, who shall make suitable modifications and resubmit.
8. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Coordination Drawing Process: Prepare coordination drawings in the following manner:

1. Schedule submittal and review of Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
4. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
5. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.
6. If Contractor prepares framing model or drawings, preparation of these drawings is the sole responsibility of the General Contractor.

D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: REVIT OR DWG operating in Microsoft Windows operating system.
2. Architectural and Structural Files can be provided in Revit or DWG. MEP/FP, civil and landscape drawings are available in DWG format.
3. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and PDF format.

4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
   a. Contractor shall execute a data licensing/use limitation agreement in the form of acceptable to the Architect.
   b. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.

1.8 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner's Project number.
4. Name of Architect and OPM.
5. Architect's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Equal to AIA Document G716 or Software-generated form with substantially the same content as indicated above, acceptable to Architect.
   1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven (7) days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

   1. The following Contractor-generated RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for approval of Contractor's means and methods.
      d. Requests for coordination information already indicated in the Contract Documents.
      e. Requests for adjustments in the Contract Time or the Contract Sum.
      f. Requests for interpretation of Architect's actions on submittals.
      g. Incomplete RFIs or inaccurately prepared RFIs.

   2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
   3. Architect's action on RFIs that may result in a change to the Contract Time, or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

      a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and OPM in writing within five (5) days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of web-based Project management software including:

   1. Project name.
   2. Name and address of Contractor.
   3. Name and address of Architect[and OPM
   4. RFI number, including RFIs that were returned without action or withdrawn.
   5. RFI description.
   6. Date the RFI was submitted.
   7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three (3) days if Contractor disagrees with response.

1.9 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Web-Based Project Software or Hosting Service: Provide, administer, and use web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project software site includes, at a minimum, the following features:
    a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    c. Document workflow planning, allowing customization of workflow between project entities.
    d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    e. Track status of each Project communication in real time, and log time and date when responses are provided.
    f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    g. Processing and tracking of contract modifications.
    h. Distributing meeting minutes.
    i. Document management for Drawings, Specifications, and coordination drawings, including revision control.
    j. Management of construction progress photographs.
    k. Mobile device compatibility, including smartphones and tablets.
2. Provide web-based Project software user licenses for use of Owner, Owner’s Manager Architect, and Architect's consultants.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
4. Available software and hosting services include, but are not limited to:
    a. Newforma, Inc.
    b. Procore Technologies, Inc.
    c. Submittal Exchange (Oracle)
    d. BidDocs
    e. PlanGrid
    f. Or equal

B. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model or CAD drawings will be provided by Architect for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Contractor, subcontractor, and other parties shall execute a release form for use of the digital data files.
4. The following digital data files will be furnished for each appropriate discipline:
    a. Floor plans.
    b. Reflected ceiling plans.
    c. Building Elevations

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.10 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
   1. Minutes: The Contractor and OPM are responsible for conducting meeting and will record significant discussions and agreements achieved. Meeting notes will be distributed by email and posted on Project Software site.

B. Preconstruction Conference: Architect, Owner and OPM will schedule and conduct a preconstruction conference before starting construction, at a time convenient to all parties no later than [7] seven days after execution of the Agreement.

   1. Attendees: Authorized representatives of Owner, OPM, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Discuss items of significance that could affect progress, including the following:

      a. Responsibilities and personnel assignments.
      b. Tentative construction schedule.
      c. Phasing.
      d. Critical work sequencing and long lead items.
      e. Designation of key personnel and their duties.
      f. Lines of communications.
      g. Use of web-based Project software.
      h. Procedures for processing field decisions and Change Orders.
      i. Procedures for RFIs.
      j. Procedures for testing and inspecting.
      k. Procedures for processing Applications for Payment.
      l. Distribution of the Contract Documents.
      m. Submittal procedures.
      n. Sustainable design requirements.
      o. Preparation of Record Documents.
      p. Use of the premises
      q. Work restrictions.
      r. Working hours.
      s. Owner's occupancy requirements.
      t. Responsibility for temporary facilities and controls.
      u. Procedures for moisture and mold control.
      v. Procedures for disruptions and shutdowns.
      w. Construction waste management and recycling.
      x. Parking availability.
      y. Office, work, and storage areas.

z. Equipment deliveries and priorities.
aa. First aid.
bb. Security.
cc. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner's Project Manager of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than ninety (90) days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.

a. Preparation of Record Documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Procedures for completing and archiving web-based Project software data files.
d. Submittal of written warranties.
e. Requirements for completing sustainable design documentation.
f. Requirements for preparing operations and maintenance data.
g. Requirements for delivery of material samples, attic stock, and spare parts.
h. Requirements for demonstration and training.
i. Preparation of Contractor's punch list.
j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
k. Submittal procedures.
l. Coordination of separate contracts.
m. Owner's partial occupancy requirements.
n. Installation of Owner's furniture, fixtures, and equipment.
o. Responsibility for removing temporary facilities and controls.

2. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: OPM will conduct progress meetings at regular intervals commensurate with Construction activities.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, OPM, Contractor, and Architect, each subcontractor, supplier, and other entity concerned with current progress or involved in

planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      1) Contract shall provide two -week look ahead schedules for review at each meeting.
   b. Review present and future needs of each entity present, including the following:

      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Deliveries.
      5) Off-site fabrication.
      6) Access.
      7) Site use.
      8) Temporary facilities and controls.
      9) Progress cleaning.
      10) Quality and work standards.
      11) Status of correction of deficient items.
      12) Field observations.
      13) Status of RFIs.
      14) Status of Proposal Requests.
      15) Pending changes.
      16) Status of Change Orders.
      17) Pending claims and disputes.
      18) Documentation of information for payment requests.

4. Minutes: The OPM will record and distribute the meeting minutes to each party present and to parties requiring information.

   a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct Project coordination meetings at biweekly or at intervals commensurate with Construction and Administrative activities. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, OPM, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these

meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

   a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

   b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

   c. Review present and future needs of each contractor present, including the following:

      1) Interface requirements.
      2) Sequence of operations.
      3) Resolution of BIM component conflicts.
      4) Status of submittals.
      5) Deliveries.
      6) Off-site fabrication.
      7) Access.
      8) Site use.
      9) Temporary facilities and controls.
      10) Work hours.
      11) Hazards and risks.
      12) Progress cleaning.
      13) Quality and work standards.
      14) Status of RFIs.
      15) Proposal Requests.
      16) Change Orders.
      17) Pending changes.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Startup construction schedule.
   2. Contractor's As-Planned Construction Schedule.
   3. Construction schedule updating reports.
   4. 2-week look ahead schedules

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

   1. Working electronic copy of schedule file, where indicated.
   2. PDF file.
   3. Four (4) paper copies, of sufficient size to display and read the entire period or schedule, as required. Minimum font size of schedule text shall be 10 point.

B. Startup construction schedule.
   1. Submittal of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Contractor's As-Planned Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
   1. Submit a working digital copy of schedule, using software indicated, copy in pdf format, and labeled to comply with requirements for submittals.

D. Construction Schedule Updating Reports: Submit with Applications for Payment.

1.4 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

1.5 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1.6 CONTRACTOR'S AS-PLANNED CONSTRUCTION SCHEDULE, GENERAL

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Scheduling Consultant: If Contractor does not have in-house capability, engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
   1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.

C. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.
   1. Prepare a separate project completion schedule for activities between the date established for Substantial Completion and Final Completion.

D. Cost Correlation: Upon Owner’s request, Contractor shall provide cashflow budget projections to allow Owner to budget and plan for periodic payments.

E. Upcoming Work Summary: Prepare weekly summary report/schedule indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
   1. Construction Activities
   2. Submittals
   3. Unanswered Requests for Information.
   4. Rejected or unreturned submittals.
   5. Notations on returned submittals.
   6. Pending modifications affecting the Work and the Contract Time.

F. Contractor's Construction Schedule Updating: Every 45 days, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting. If Architect and Owner’s Project Manager feel that more frequent updating is needed due to the progress of the work, monthly updates will be required.

   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
   2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
   3. As the Work progresses, indicate final completion percentage for each activity.

G. Recovery Schedule: When periodic update indicates the Work is fourteen (14) or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to

working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Distribution: Distribute copies of accepted schedule to Architect and Owner's Project Manager Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1.7 STARTUP CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within five (5) days of date established for commencement of the Work. Schedule shall cover period of time between Commencement of the Work and acceptance of the As-Planned Construction Schedule.

1.8 CPM SCHEDULE REQUIREMENTS

A. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
   1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than (30) thirty days after date established for commencement of the Work.

B. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
   1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
      a. Preparation and processing of submittals.
      b. Mobilization and demobilization.
      c. Work by Owner and Owner's Contractors
      d. Purchase of materials.
      e. Delivery.
      f. Fabrication.
      g. Utility interruptions.
      h. Installation.
      i. Testing and inspection.
      j. Commissioning.
      k. Punch list and final completion.
      l. Activities occurring following final completion.

   2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
   3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
   4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

C. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

D. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float."

E. Schedule Updating: Concurrent with making revisions to schedule.

1.9 2-WEEK LOOK AHEAD SCHEDULES

A. Concurrently with Progress Meetings, prepare two-week look a head schedules describing planned activities, deliveries, and other significant events.

B. The Schedule can be prepared in the following formats:
1. Detailed schedule using scheduling software
2. A bar chart schedule prepared using a spreadsheet software.
3. A written schedule breaking down activities by week and number of days.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013233 – PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Preconstruction photographs.
      a. Preconstruction Photographs before the start of each Phase
   2. Periodic construction photographs.

B. Related Requirements:
   1. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
   2. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.3 INFORMATIONAL SUBMITTALS

A. Digital Photographs: Submit image files within 3 (three) days of taking photographs.
   1. Submit photos by uploading to web-based project software site. Include copy of key plan indicating each photograph's location and direction.
   2. Identification: Provide the following information with each posting on web-based project software site:
      a. Date photograph was taken.
      b. Folders with Description of location, vantage point, and direction if photo

1.4 QUALITY ASSURANCE

A. Photographer Qualifications: The Contractor may take and prepare the photographs as long as they are clear, in focus and accurately record the progress of the work. A professional photographer is not required unless the quality of the photographs taken by the Contractor are not acceptable to the Architect and Owner.

1.5 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of twelve (12) megapixels, and at an image resolution of not less than

3200 by 2400 and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

1.6 CONSTRUCTION PHOTOGRAPHS

A. Preconstruction Photographs: Before starting construction take photographs of Project site and surrounding properties, existing building, and existing items to remain during construction, from different vantage points, as directed by the Architect and OPM.

B. Take photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.

C. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Periodic Construction Photographs: Take a minimum of twenty (20) photographs each week, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
   1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
   2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
   3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

B. Web-Based Project Management Software: PDF print out of a fully populated submittal log from the project management software is acceptable.

1.5 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:
   1. Project name.
   2. Date.
   3. Name of Architect.
   4. Name of Contractor.
   5. Name of firm or entity that prepared submittal.
   6. Names of subcontractor, manufacturer, and supplier.
   7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
   8. Category and type of submittal.
   9. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
   10. Drawing number and detail references, as appropriate.
   11. Indication of full or partial submittal.
   12. Remarks.
   13. Signature of transmitter.
   14. Stamp or attached document stating that the Submittal has been reviewed, coordinated an approved by the General Contractor and stating that the submittal is in general conformance with the Contract Documents.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

E. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   1. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
   2. Notifications: Project Software shall be programmed to control notifications and distribution of documents and notifications.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
    a. Architect will withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow fourteen (14) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow seven (7) days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.7 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.

B. PDF Format: Create a single bound file, or group products into a single larger file.
1. Submittals containing multiple pdf files of individual components will be returned without action.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
   1. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
      a. Physical samples shall be delivered to the Project Site or Architect's Office
   2. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   3. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

      a. Number of Samples: Submit two (2) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

   4. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
      a. Number of Samples: Submit three (3) sets of Samples. Architect will retain [two] Sample sets; remainder will be returned.
         1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
         2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three (3) sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

F. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

G. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

H. Certificates:

   1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be

signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.

2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

I. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a registered design professional in the Commonwealth of Massachusetts, are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

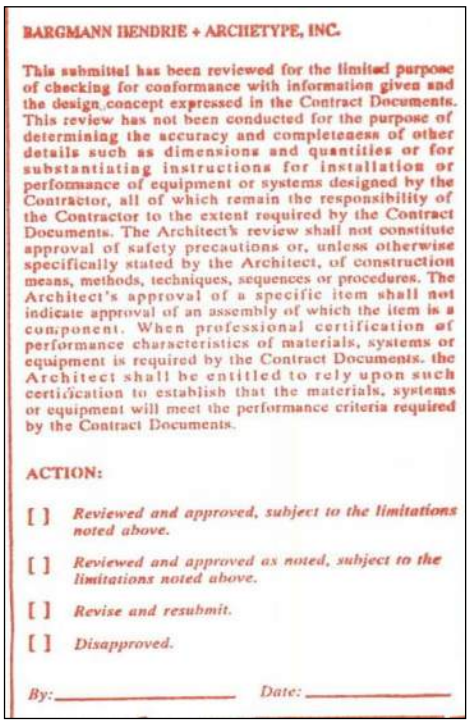
1.9 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or indication in web-based Project software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1.10 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required.
   1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
   2. Submittals by Web-Based Project Software: Architect will mark-up PDF of reviewed submittal and indicate, on Project software website, the appropriate action.


BARGMANN HENDRIE + ARCHETYPE, INC.

This submittal has been reviewed for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. This review has not been conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities or for substantiating instructions for installation or performance of equipment or systems designed by the Contractor, all of which remain the responsibility of the Contractor to the extent required by the Contract Documents. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component. When professional certification of performance characteristics of materials, systems or equipment is required by the Contract Documents, the Architect shall be entitled to rely upon such certification to establish that the materials, systems or equipment will meet the performance criteria required by the Contract Documents.

ACTION:

[ ] *Reviewed and approved, subject to the limitations noted above.*

[ ] *Reviewed and approved as noted, subject to the limitations noted above.*

[ ] *Revise and resubmit.*

[ ] *Disapproved.*

*By:*_____ *Date:*_____


DELEGATED DESIGN SUBMITTAL REVIEW

☐ REVIEWED

☐ REVIEWED AS NOTED (RESUBMITTAL REQUIRED)

☐ NOT REVIEWED

Review is solely for the purpose of evaluating compliance of the subject design with the performance requirements set forth in the Contract Documents. Neither this submittal review nor any participation in reviews or comments with respect to preliminary or iterative designs shall in any matter or respect diminish or otherwise affect the Contractor's and its Designer's exclusive responsibility for the adequacy, completeness, suitability, reliability, conformity, and compliance of the design with the requirements of the Contract Documents, applicable codes and standards, and applicable professional practices standards.

BY: _____

DATE: _____

BARGMANN HENDRIE + ARCHETYPE, INC.

A. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

B. For certain submittals and physical samples, the Architect may attach a submittal response form and provide comments or actions into a single memo format document. The submittal response form contains the following language:

C.

BARGMANN HENDRIE + ARCHETYPE, INC.
Architecture | Planning | Interior Design

9 Channel Center Street
Suite 300
Boston, MA 02210

617 350 0450
bha@bhplus.com
www.bhplus.com

submittal response form

date:

project name & number: Davey Lopes Recreation Center
BH+A Project No.

submittal **000000-01-0 Submittal name**

distribution:

This submittal has been reviewed for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. This review has not been conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities or for substantiating instructions for installation or performances of equipment or systems designed by the Contractor, all of which remain the responsibility of the Contractor to the extent required by the Contract Documents. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component. When professional certification of performance characteristics of materials, systems or equipment is required by the Contract Documents, the Architect shall be entitled to rely upon such certification to establish that the materials, systems or equipment will meet the performance criteria required by the Contract Documents.

action: Reviewed and approved, subject to the limitations noted above

Reviewed and approved as noted, subject to the limitations noted above.

Revise and Resubmit

Disapproved

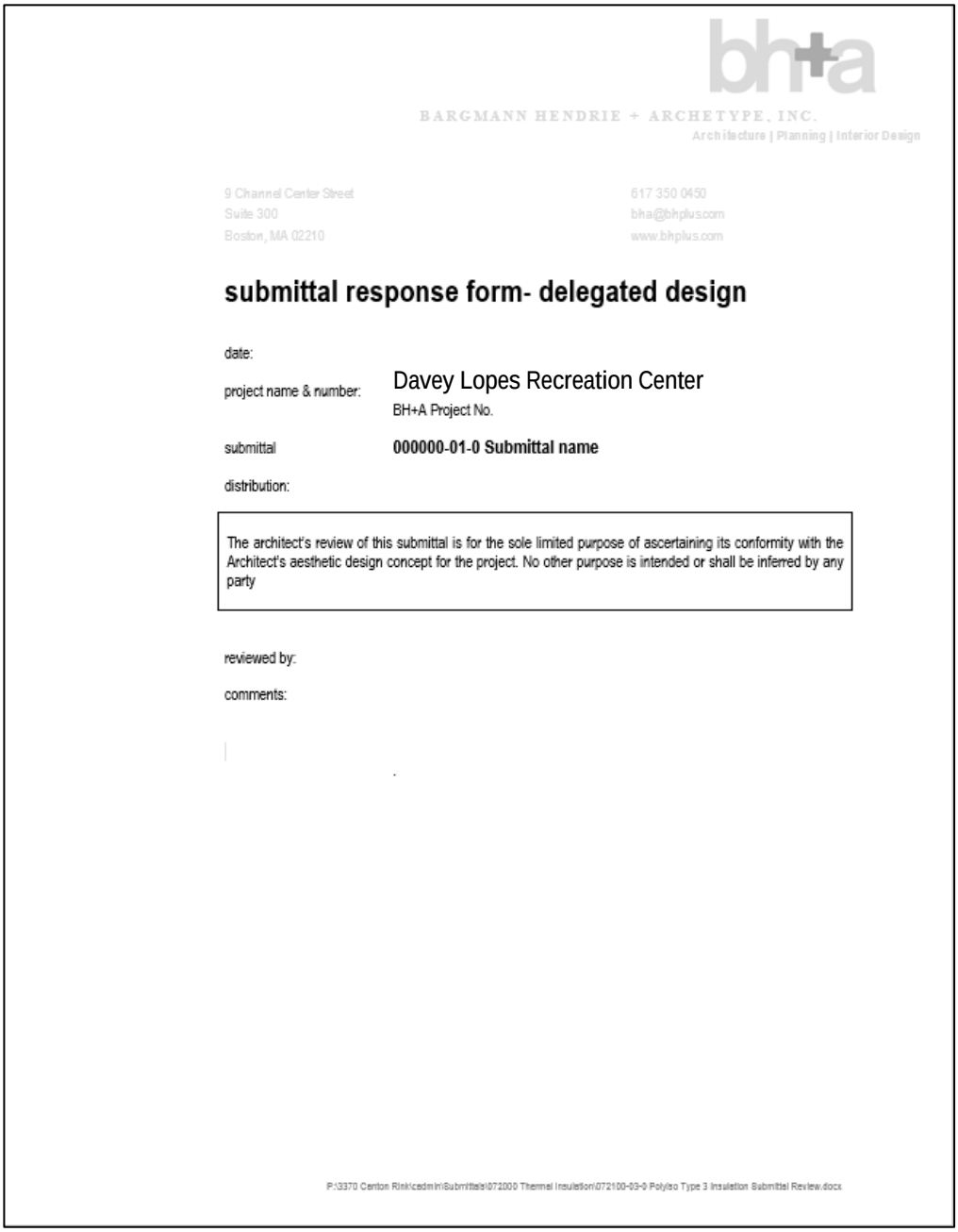
(Ctrl)

reviewed by:

comments:

P:\3370 Canton Rink\cadmin\Submittals\072000 Thermal Insulation\072100-03-0 Polyiso Type 3 Insulation Submittal Review.docx

D. Architect's Delegated Design Response Form:



BARGMANN HENDRIE + ARCHETYPE, INC.
Architecture | Planning | Interior Design

9 Channel Center Street
Suite 300
Boston, MA 02210

617 350 0450
bha@bhplus.com
www.bhplus.com

submittal response form- delegated design

date:

project name & number: Davey Lopes Recreation Center
BH+A Project No.

submittal **000000-01-0 Submittal name**

distribution:

The architect's review of this submittal is for the sole limited purpose of ascertaining its conformity with the Architect's aesthetic design concept for the project. No other purpose is intended or shall be inferred by any party

reviewed by:

comments:

P:\3370 Canton Rink\cadmin\Submittals\072000 Thermal Insulation\072100-03-0 Polyiso Type 3 Insulation Submittal Review.docx

E.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Specific test and inspection requirements are not specified in this Section.

C. Loam Testing: The Contractor shall collect, submit, and recommend soil improvement amendments of planting soil as specified in Landscape documents.

D. Test Reports: Control shall organize and post all Test Results on the Web-based Project Management software.
1. Organize by type of test
2. File in chronological order or by test number

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five (5) previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

D. Mockups: Full-size physical assemblies that are constructed as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.
2. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

1.4 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional, licensed in the Commonwealth of Massachusetts, are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 ACTION SUBMITTALS- REVIEWED ONLY

A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or

certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1. Calculations, certifications and stamped and signed shop drawings shall be reviewed by the Architect for conformance with project requirements. Final Delegated Design is the responsibility of the responsible design professional.

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspection.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.

3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

C. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

D. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

E. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
    a. Provide test specimens representative of proposed products and construction.
    b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.

F. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location indicated or, if not indicated, as approved by Architect.
2. Notify Architect seven (7) days in advance of dates and times when mockups will be constructed. Coordinate date for observation with a regularly scheduled project meeting.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

G. Integrated Exterior Mockups: Construct integrated exterior mockup in agreed upon location. Coordinate installation of exterior envelope materials and products for which mockups are

required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.

H. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
   2. Costs for retesting and reinspection construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
   3. Testing that will be provided by the Owner, include, but may not be limited to:
      a. Hazardous Material Sampling and Monitoring
      b. Concrete Testing
      c. Masonry Testing
      d. Masonry Reinforcing Inspection
      e. Reinforcing Steel Inspections
      f. Shotcrete and Steel Reinforcing Inspections
      g. Earthwork
      h. Environmental Monitoring
      i. Soil Classification for removal/disposal.

B. Usually retain “Contractor Responsibilities” Paragraph below to address testing and inspection and other quality-control activities not explicitly assigned to Owner. See the Evaluations.

C. Retesting/Reinspection: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspection, for construction that replaced Work that failed to comply with the Contract Documents.

D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

F. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

   1. Access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for OPM and Architect's reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
2. DOE - Department of Energy; www.energy.gov.
3. EPA - Environmental Protection Agency; www.epa.gov.
4. OSHA - Occupational Safety & Health Administration; www.osha.gov.

C. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
   1. Project includes provisions for maintaining building, pool, and gymnasium access during the 2025 summer camp season. Refer to Period 1 and 2 restrictions and requirements.

B. Related Requirements:
   1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, the Owner, OPM, Architect, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Existing sewer utilities may be lawfully used for disposal of sanitary waste.

C. Water Service: Existing water service may be used by Contractor.

D. Electric Power Service: Existing electrical service may be used by the Contractor.

E. Water and Electrical Service from Existing System:. If sufficient water and power are not available from existing building, Contractor shall provide at no cost to the Owner.

1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within [15] fifteen days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Egress Walkway: Submit engineered shop drawings for temporary egress walkway from the back of the natatorium to grade adjacent to the filter room door.

D. Fire-Safety Program: Prepare report and show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

F. Noise and Vibration Control Plan: Identify construction activities that may impact adjacent site:

1. Methods used to meet the goals and requirements of the Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.

G. File and obtain required permits for trailers and temporary construction signage.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts.

B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.

C. Construction Gate Lock: Provide a “Knox” Padlock at one entry gates Coordinate model and key requirement with Porvidence Fire Department.
   1. Exterior Model 3370, UL listed
   2. Black and red with “FIRE DEPT” labeled on exterior.

D. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil (0.25-mm) minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

E. Plywood:
   1. Temporary Enclosures: At Building Exterior Oriented-Strand-Board Sheathing: DOC PS 2. Exposure 1
   2. Protection of Pavement and Surfacing: Minimum 5/8 inch exterior grade CDX plywood sheathing

2.2 CONTRACTOR FIELD OFFICE AND STORAGE

A. Field Offices: Contractor may utilize a space within the existing building or provide prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. General Contactor’s Trailer shall provide meeting space for 10 people.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.
   3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of [8] eight at each return-

air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

A. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
1. Contractor may use existing sanitary facilities until renovations of the toilet rooms begins.
2. Contractor shall not use new/renovated sanitary facilities.

D. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

E. Electric Power Service: Provide electric distribution system of sufficient size, capacity, and power characteristics required for construction operations.

F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

G. Telephone Service: Contractors site Superintendent, Project Managers and other construction personnel designated by the Contractor shall have use of a cellular telephone with voice, text, camera, and web access.

H. Electronic Communication Service: Contractor shall Provide secure Wi-Fi wireless connection to internet with provisions for access by Contractor and secure access for the Owner's Project Manager and Architect.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:
1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Utilize designated area within existing building for temporary field offices.
3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Parking: Contractor may use area within the Construction Contract limits for parking.
1. On-street parking is available around the site.
2. Lawfully park, do not block driveways, streets, or public sidewalks.
3. Do not park construction vehicles or trailers on the street.

C. Storage and Staging: Use designated areas of Project site for storage and staging needs.

D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

E. Project Signs: Provide Project signs as indicated and specified in Section 015813. Unauthorized signs are not permitted.
1. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

a. Provide temporary, directional signs for construction personnel and visitors.

2. Maintain and touch up signs, so they are legible at all times.

F. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Temporary Erosion and Sedimentation Control: : Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent parkland, shoreline, and driveways. Comply with requirements of authorities having jurisdiction, and requirements specified in the Project Documents.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction. Pet-Control services shall be scheduled on a regular basis throughout construction with reports filed with the OPM and Authorities having jurisdiction.

G. Site Enclosure Fence: Before construction operations begin furnishing and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

2. Coordinate extent of fence with Project Phasing Requirements

3. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

K. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.

7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, which become wet during the course of construction and remain wet for [48] forty-eight hours are considered defective and require replacing.
b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for [48] forty-eight hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within [48] forty-eight hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
1. Maintenance: Maintain facilities in good operating condition until removal. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

END OF SECTION 015000

SECTION 015813 - TEMPORARY PROJECT SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the design requirements for the project identification signage and temporary directional signage

B. Painting of framework and supports (work is not part of Section 099100)

C. The contractor shall obtain all relative permits for installation of the temporary project sign.

D. Related Sections include the following:
1. Section 061000- Rough Carpentry
2. Section 015000- Temporary Facilities and Controls

1.3 SUBMITTALS

A. Shop Drawing: Submit shop drawing showing construction, graphics and color .

1.4 PERMITS

A. Submit drawings and obtain the required permits from the City of Newton. Permit fees for signs have been waived.

PART 2 - PRODUCTS

A. Lumber and Plywood: Comply with requirements in Section 061000.

B. Painting: Basis of Design Paint Systems are by Sherwin Williams. Manufacturers providing or equal paint products include:
1. Benjamin Moore & Co.
2. PPG Paints, PPG Architectural Coatings
3. California Paints
4. Or approved equal

PART 3 - EXECUTION

A. Project Identification Sign: Prepare One (1) Project signs in size indicated.
   1. Install Sign as directed by the Owner and Architect
   2. Do not permit installation of unauthorized signs.
   3. Engage an experienced sign fabricator to apply graphics for Project identification signs. Comply with details indicated.
   4. Construct sign of exterior-type Grade B-B high-density concrete form overlay plywood in, no less than 5/8 inch in thickness. Support on posts or framing of preservative-treated wood or steel.
   5. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer or provide weatherproof acrylic sheet over face of sign.
   6. Multiple Colors will be used for field, border and text.
   7. Paint rear face of sign, edges and support framing to protect material
   8. Maintain sign throughout construction; relocate as required. Provide a temporary supports system as required.

B. Paint Systems for Signage Support:
   1. Would Framing Supports:
      a. Prime Coat: Primer, latex for exterior wood.
         1) S-W Exterior Latex Primer, B42, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
      b. Intermediate Coat: Latex, exterior, matching topcoat.
      c. Topcoat: Latex, exterior, satin:
         1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

3.2 SIGNAGE TYPES

A. Temporary Construction Identification Sign: 4 Feet by 5 feet (+/-) Sign Text: (Final Artwork and Layout will be provided by Architect in electronic format to Contractor.) Sign shall include, but not limited to:
   1. Painted Field with border.
   2. Name of Project
   3. Color Rending
   4. City Seal
   5. Names including:
      a. Owner
      b. City Official/Committee
      c. Funding Source
      d. Architect
      e. Architect’s Consultants
      f. General Contractor

END OF SECTION

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. This Section is intended to clarify significant changes in specified products or equipment and the information required by the Architect to evaluate the “or equal” nature of a proposed product.

C. Related Requirements:
1. Section 011000 “Summary’ for list of proprietary specifications.
2. Section 012500 "Substitution Procedures" for requests for substitutions.
3. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual

characteristics, and other special features and requirements for purposes of evaluating comparable products (or equal products) of additional manufacturers named in the specification.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications. Submit a comparable product request, if applicable.

1.4 ACTION SUBMITTALS

A. Comparable Product Request Submittal: Submit request for consideration of comparable product not listed in the specifications. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven (7) days of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within seven (7) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1.6 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

B. Use of an approved comparable product or substitutions shall include all work and costs associated with the change including preparation of substrates, reconfiguration of space, power requirements, piping, and similar conditions.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.8 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on

product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

    a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:

1. List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.

a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: …"

2. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience **will** be considered.

a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

3. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

D. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
2. Evidence that proposed product provides specified warranty.
3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
4. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
1. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

B. Related Requirements:
1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

a. Contractor's superintendent.
b. Trade supervisor responsible for cutting operations.
c. Trade supervisor(s) responsible for patching of each type of substrate.
d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affecting by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Certificates: Submit certificate signed by land survey and professional engineers certifying that location and elevation of improvements comply with requirements.
1. Refer to Section 011400 Work Restriction for specific requirements.

B. Certified Surveys: Submit copies signed by land surveyor in quantities required by Authorities having jurisdiction.

C. Final Property Survey: Submit number of copies required by Authorities having jurisdiction showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before

fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points

promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

E. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Salvaging nonhazardous demolition and construction waste.
   2. Recycling nonhazardous demolition and construction waste.
   3. Disposing of nonhazardous demolition and construction waste.

B. It is the intent of the Project to have demolition, construction, and solid waste recycled to the greatest extent possible. This is a goal whether or not required by local or State ordinance or law.

C. Related Requirements:
   1. Section 024119 Selective Demolition for disposition of demolished building elements, and site elements.
   2. Division 31 Section or Drawing Notes related "Site Clearing and Site Preparation" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner’s property.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
   1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.
   1. Rhode Island Department of Environmental Protection (DEM) and Rhode Island Department of State Solid Waste Regulation No.07 Facilities that Process Construction and Demolition Debris, (250-RICR-140-05-7)
      a. https://rules.sos.ri.gov/regulations/part/250-140-05-7

PART 2 - PRODUCTS

2.1 RECYCLING RECEIVERS AND PROCESSORS

A. Subject to compliance with requirements, Guidance is provided by the Rhode Island Resource Recovery Corporation (RIRRC).
   1. https://rirrc.org/

2.2 PERFORMANCE REQUIREMENTS

A. Facilitate recycling and salvage of materials including the following:
   1. Demolition Waste:
      a. Asphalt paving.
      b. Concrete.
      c. Concrete reinforcing steel.
      d. Brick.
      e. Concrete masonry units.
      f. Wood studs.
      g. Wood joists.
      h. Plywood and oriented strand board.
      i. Wood paneling.
      j. Wood trim.
      k. Structural and miscellaneous steel.
      l. Rough hardware.
      m. Roofing.

n. Doors and frames.
o. Door hardware.
p. Windows.
q. Glazing.
r. Equipment.
s. Cabinets.
t. Plumbing fixtures.
u. Piping.
v. Supports and hangers.
w. Valves.
x. Mechanical equipment.
y. Electrical conduit.
z. Copper wiring.
aa. Lighting fixtures.
bb. Lamps.
cc. Ballasts.
dd. Electrical devices.

2. Construction Waste:
   a. Masonry and CMU.
   b. Lumber.
   c. Wood sheet materials.
   d. Wood trim.
   e. Metals.
   f. Roofing.
   g. Insulation.
   h. Gypsum board.
   i. Tile and flooring
   j. Piping.
   k. Electrical conduit.
   l. Packaging: Salvage or recycle 100 percent of the following uncontaminated packaging materials:
      1) Paper.
      2) Cardboard.
      3) Boxes.
      4) Plastic sheet and film.
      5) Polystyrene packaging.
      6) Wood crates.
      7) Wood pallets.
      8) Plastic pails.
   m. Construction Office Waste: Salvage/ recycle 100 percent of the following construction office waste materials:
      1) Paper.
      2) Aluminum cans.
      3) Glass containers.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within five (5) days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Sale and Donation: Not permitted on Project site.

B. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

C. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

D. Plumbing Fixtures: Separate by type and size.

E. Lighting Fixtures: Separate lamps by type and protect from breakage.

F. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

E. Metals: Separate metals by type.

F. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, and other components by material and size.

G. Conduit: Reduce conduit to straight lengths and store by material and size.

H. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:
1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces, and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:
1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner’s property.

C. Burning: Do not burn waste materials.

END OF SECTION 017419

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.
   5. Repair of the Work.

B. Related Requirements:
   1. Section 013233 "Photographic Documentation" for submitting final completion construction photographic documentation.
   2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
   3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   4. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at final completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of ten [10] days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of ten [10] days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."

6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of ten (10) days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, which must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit final completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within fifteen (15) days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

E. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
j. Remove labels that are not permanent.
k. Wipe surfaces of mechanical and electrical equipment[, elevator equipment,] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.

o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
p. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:
1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Architect and Owner by uploading to web-based project software site, or by email to Architect. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least thirty (30) days before commencing demonstration and training and requesting inspection for Substantial Completion. Architect will comment on whether general scope and content of manual are acceptable.
1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within fifteen (15) days of receipt of Architect's comments and prior to commencing demonstration and training.
2. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Final Completion
3. prior to commencing demonstration and training.

D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components

of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, roll or fold drawings and submit separately from manual.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
   1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
   2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
   3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:
   1. Type of emergency.
   2. Emergency instructions.
   3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
   1. Fire.
   2. Flood.
   3. Gas leak.
   4. Water leak.
   5. Power failure.
   6. Water outage.
   7. System, subsystem, or equipment failure.
   8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:
   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include

information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
   1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
   1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
      a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.
   2. Troubleshooting guide.
   3. Precautions against improper maintenance.
   4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   5. Aligning, adjusting, and checking instructions.
   6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.
   4. Miscellaneous record submittals.

B. Related Requirements:
   1. Section 017300 "Execution" for final property survey.
   2. Section 017700 "Closeout Procedures" for general closeout procedures.
   3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit copies of record Drawings as follows:
      a. Initial Submittal:
         1) Submit PDF electronic files of scanned record prints and one (1) of file prints.
         2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
      b. Final Submittal:
         1) Submit PDF electronic files of scanned record prints three (3) set(s) of prints.
         2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
   1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
   1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Accurately record information in an acceptable drawing technique.
      c. Record data as soon as possible after obtaining it.
      d. Record and check the markup before enclosing concealed installations.
      e. Cross-reference record prints to corresponding photographic documentation.
   2. Content: Types of items requiring marking include, but are not limited to, the following:
      a. Dimensional changes to Drawings.
      b. Revisions to details shown on Drawings.
      c. Depths of foundations.
      d. Locations and depths of underground utilities.
      e. Revisions to routing of piping and conduits.
      f. Revisions to electrical circuitry.
      g. Actual equipment locations.
      h. Duct size and routing.
      i. Locations of concealed internal utilities.
      j. Changes made by Change Order or [Construction] [Work] Change Directive.
      k. Changes made following Architect's written orders.
      l. Details not on the original Contract Drawings.
      m. Field records for variable and concealed conditions.
      n. Record information on the Work that is shown only schematically.
   3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
   4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
   5. Mark important additional information that was either shown schematically or omitted from original Drawings.
   6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
   1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
   2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.

3. Refer instances of uncertainty to Architect through Construction Manager for resolution.
4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Note related Change Orders, record Product Data,] and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. If possible, a Change Order proposal should include resubmitting updated Product Data. This eliminates the need to mark up the previous submittal.
4. Note related Change Orders, record Specifications, and record Drawings where applicable.

C. Format: Submit record Product Data as annotated PDF electronic file.
1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.
1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Instruction in operation and maintenance of systems, subsystems, and equipment.
   2. Demonstration and training video recordings.
   3. Video Recording Shall be Required for:
      a. HVAC Systems
      b. Plumbing Systems
      c. Lighting Control Systems
      d. Kitchen Equipment
      e. A separate Video for field components of Building Control System
      f. Security and Access Control Systems

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two (2) copies within seven (7) days of end of each training module.
   1. Identification: On each copy, provide an applied label with the following information:
      a. Name of Project.
      b. Name and address of videographer.
      c. Name of Architect.
      d. Name of Construction Manager.
      e. Name of Contractor.
      f. Date of video recording.
   2. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A videographer who is experienced photographing demonstration and training events similar to those required.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
      c. Operating standards.
      d. Regulatory requirements.
      e. Equipment function.
      f. Operating characteristics.
      g. Limiting conditions.
      h. Performance curves.
   2. Documentation: Review the following items in detail:
      a. Emergency manuals.
      b. Systems and equipment operation manuals.
      c. Systems and equipment maintenance manuals.
      d. Product maintenance manuals.
      e. Project Record Documents.
      f. Identification systems.
      g. Warranties and bonds.
      h. Maintenance service agreements and similar continuing commitments.
   3. Emergencies: Include the following, as applicable:
      a. Instructions on meaning of warnings, trouble indications, and error messages.
      b. Instructions on stopping.
      c. Shutdown instructions for each type of emergency.
      d. Operating instructions for conditions outside of normal operating limits.
      e. Sequences for electric or electronic systems.
      f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
5. Startup procedures.
    a. Equipment or system break-in procedures.
    b. Routine and normal operating instructions.
    c. Regulation and control procedures.
    d. Control sequences.
    e. Safety procedures.
    f. Instructions on stopping.
    g. Normal shutdown instructions.
    h. Operating procedures for emergencies.
    i. Operating procedures for system, subsystem, or equipment failure.
    j. Seasonal and weekend operating instructions.
    k. Required sequences for electric or electronic systems.
    l. Special operating instructions and procedures.
6. Adjustments: Include the following:
    a. Alignments.
    b. Checking adjustments.
    c. Noise and vibration adjustments.
    d. Economy and efficiency adjustments.
7. Troubleshooting: Include the following:
    a. Diagnostic instructions.
    b. Test and inspection procedures.
8. Maintenance: Include the following:
    a. Inspection procedures.
    b. Types of cleaning agents to be used and methods of cleaning.
    c. List of cleaning agents and methods of cleaning detrimental to product.
    d. Procedures for routine cleaning.
    e. Procedures for preventive maintenance.
    f. Procedures for routine maintenance.
    g. Instruction on use of special tools.
9. Repairs: Include the following:
    a. Diagnosis instructions.
    b. Repair instructions.
    c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    d. Instructions for identifying parts and components.
    e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

A. Assemble educational materials necessary for instruction into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner, with at least fourteen (14) days' advance notice.

C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.
   1. Submit video recordings on thumb drive.
   2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
   3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
   4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
      a. Name of Contractor/Installer.
      b. Business address.
      c. Business phone number.
      d. Point of contact.
      e. Email address.

B. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
   1. Film training session(s) in segments not to exceed 15 minutes.
      a. Produce segments to present a single significant piece of equipment per segment.
      b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
      c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

C. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

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SECTION 024113 - UTILITY LINE REMOVAL

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. The work under this Section shall consist of existing underground drainage pipes and utility lines, including associated items of work, as shown on the Plans, and as specified herein.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
   1. Section 31 00 00 - EARTH MOVING

1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.3 SUBMITTALS (Not Used)

1.4 QUALITY ASSURANCE

A. The Contractor shall perform Work in accordance with The State of Rhode Island and the City of Providence rules, regulations, laws and ordinances, and any other authorities having jurisdiction.

1.6 PERMITS, CODES AND SAFETY REQUIREMENTS

A. Work shall conform to the Contract Drawings and Specifications and shall comply with applicable codes and regulations. Present in writing to the Architect, all conflicts between the Contract Drawings, Specifications, and applicable codes and regulations, for resolution before commencing the Work.

B. Comply with all rules, regulations, laws and ordinances of the City of Providence and the State of Rhode Island, and of all other authorities having jurisdiction. All labor, materials, equipment, and services necessary to make the work comply with such requirements shall be provided without additional cost to the Owner.

C. The Contractor shall not close any street, sidewalk, or passageway except as indicated on the Contract Drawings. The Contractor shall so conduct his operations as to interfere as little as possible with the use ordinarily made of roads, driveways, sidewalks, or other facilities near enough to the work to be affected thereby.

D. The Contractor shall procure and pay for all permits and licenses required for the complete work specified herein and shown on the Contract Drawings at no additional cost to the Owner. Arrange and pay for legal off-site disposal of all excess excavated materials, obtain proper disposal receipts from the applicable disposal facility for verification.

E. Notify "Dig Safe" and the Owner before starting work; comply fully with utility company requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 DEMOLITION

A. The known existing drainage and utility pipelines are shown on the drawings in their approximate locations. Drainage and utility pipelines include but are not limited to reinforced concrete pipe (RCP), PVC, HDPE, ductile iron, cast iron, CMP, clay, etc.

B. Locate drainage pipes and utility lines to be removed.

C. Field verify, if required, the depth of the drainage pipes and utility lines to be removed.

D. Any active pipeline lines encountered by the Contractor during the construction activities shall be isolated by a method approved by the Engineer.

E. Excavate and remove the drainage pipes and utility lines at the locations shown on the plans or as directed by the Engineer. Sawcut the pipe and lateral connections, prior to removal, if the pipe is not removed at the joint.

F. Cap all pipe openings in accordance with the City of Providence standards.

G. All excavated materials shall be removed and disposed of off the Owner’s property unless otherwise noted on the plans.

3.2 BACKFILL

A. Backfill is not included in this section and shall be performed as required by the plans and requirements of Section 31 00 00 – EARTH MOVING.

END OF SECTION 024113

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior or interior of building or structure and site elements.

B. Related Requirements:
1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.

C. Selective Demolition Work requires coordination with Section 042000 Unit Masonry.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including Drawings, which indicates the measures proposed for protecting individuals and property**, for environmental protection, for dust control ,and noise control**. Indicate proposed locations and construction of barriers.

C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that

recovery was performed in accordance with EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.5 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: **Universal** certified by an EPA-approved certification program.

1.6 FIELD CONDITIONS

A. Owner will **not** occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:
   a. Loose furniture
   b. Building equipment
   c. Athletic equipment

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials:
1. Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is **on** for review and use. Examine report to become aware of locations where hazardous materials are present.
   a. Hazardous material remediation is specified in Section in the Project Manual.

E. On-site sale of removed items or materials is not permitted.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs. Comply with Section 013233 "Photographic Documentation."

3.2 PREPARATION

A. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

B. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location **and cleaned** and reinstalled in their original locations after selective demolition operations are complete.

D. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment in accordance with 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

A. Existing Services/Systems to Remain: Maintain utilities and building systems and equipment to remain and protect against damage during selective demolition operations.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.
   1. Demolish and remove existing building systems, equipment, and components indicated on Drawings to be removed.
      a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
      b. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
      c. Equipment to Be Removed: Disconnect and cap services and remove equipment and components.

   2. Remove and reinstall/salvage existing building systems, equipment, and components indicated on drawings to be removed and reinstalled or removed and salvaged:
      a. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment and components; when appropriate, reinstall, reconnect, and make equipment operational.

3.4 SALVAGE/REINSTALL

A. Removed and Reinstalled Items:
   1. Clean and repair items to functional condition adequate for intended reuse.
   2. Pack or crate items after cleaning and repairing. Identify contents of containers.
   3. Protect items.
   4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

   1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
   2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering, and chopping. Temporarily cover openings to remain.
   3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
   5. Maintain fire watch after flame-cutting operations as required by authorities having jurisdiction.

6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.6 MASONRY DEMOLITION AND DISMANTLING - GENERAL

A. Provide and install all temporary shoring, bracing and support to surrounding construction before beginning removal. Removal shall be done slowly and methodically to maintain stability to all remaining elements at all times. All demolition and dismantling of existing masonry shall be coordinated with the Masonry Subcontractor. Shoring and bracing of existing elements and portions of the structure that are affected by the masonry work shall provide.

3.7 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete:
1. Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Masonry demolition for new masonry openings shall be performed in manner to allow toothing of new or salvaged masonry units to match coursing and joint patterns.
1. Coordinate masonry openings with new loose lintels and flashings.

C. Carefully remove designated masonry, maintaining support to all surrounding and supported elements that are otherwise dependent upon the masonry being removed for support or stability.
1. Where removed brickwork supports masonry or other overburden, remove it in a sequential manner, installing temporarily shoring or cripples to be sequentially removed when the brickwork is reinstalled.
2. Following removal of face brick, inspect and remove additional masonry that is loose, damaged or can be separated with unassisted hands.
3. Clean the exposed surfaces of the remaining material and remove shards of material that have become loose during work or have shifted from their proper positions. Notify the Architect immediately if additional brickwork from the back-up wythes needs to be removed before proceeding with work.
4. Notify the Architect of any masonry beyond immediate work area, which becomes loosened during work. Stop work immediately, provide additional bracing and review with Architect before resuming.

5. Protect the existing interior structure from the external weather and from dust and debris caused by these operations. Provide weather protection as needed until the external envelope is restored.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished and then break up and remove.

E. Resilient Floor Coverings: Remove floor coverings and adhesive in accordance with recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 075423 Thermoplastic-Polyolefin (TPO) roofing and Section 076111 Sheet Metal Roofing for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site **and recycle or dispose of them in accordance with Section 017419 "Construction Waste Management and Disposal."**
1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Coordinate first subparagraph below with use of elevators, stairs, or building entries permitted by building manager.
4. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.9 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.10 SELECTIVE DEMOLITION SCHEDULE

A. Remove work shown on demolition drawings.

B. Existing to Remain: Portions of building indicated as existing on drawings.

END OF SECTION 024119

SECTION 028213 - ASBESTOS ABATEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including General Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.2 CONSULTANT

A. The Owner shall retain an independent contractor for the purposes of project management and monitoring during Asbestos Abatement. The Consultant will represent the Owner in all phases of the abatement project at the discretion of the Owner. The Asbestos Abatement Contractor will regard the Consultant's direction as authoritative and binding as provided herein, in matters particularly but not limited to approval of work areas, review of monitoring results, completion of the various segments of work, final completion of the abatement, submission of data, and daily field punch list items.

1.3 USE OF THE CONTRACT DOCUMENTS

A. It shall be incumbent upon the Contractor to visit the Site and determine what exists, its condition, and what will be required to accomplish the Work intended by the Contract Documents. No increase in the Contract Sum will be permitted as a result of the Contractor's failure to visit the Site and understand the existing conditions.

B. All work shall comply with the Contract Documents and with applicable Codes, laws, regulations, and ordinances wherever applicable. The most stringent of all the foregoing shall govern.

C. It is not intended that the Specifications show every detail of the Work, but the Contractor shall be required to furnish within the Contract Sum all material and labor necessary for the completion of the Work in accordance with the intent of the Specifications.

D. In case of ambiguity among the Contract documents, the more stringent requirement as determined by the Consultant shall prevail.

E. The Work of this Contract includes making modifications as necessary, subject to approval by Owner in consultation with the Consultant, to correct any conflicts.

F. All items, not specifically mentioned in the Specifications but implied by trade practices to complete the work, shall be included.

G. Whenever there is a conflict or overlap within these specifications and between applicable codes and regulations, the most stringent provision specified shall apply

1.4 CONTRACTOR QUALIFICATIONS

A. The Contractor selected must appear on the approved list of Asbestos Abatement contractors on file at the State of Rhode Island Department of Health (RI DOH) and hold a valid license for asbestos abatement within the State of Rhode Island.

B. Submit a written statement regarding whether the Contractor has ever been found out-of-compliance with federal or state asbestos and/or lead regulations pertaining to worker protection, removal, transport, or disposal.

C. The Contractor shall be responsible for obtaining all necessary or required permits from the Federal, State and local agencies having jurisdiction over this asbestos abatement project. Failure on behalf of the Contractor to obtain these permits shall not result in any

D. extension for the timely results of completion of the work set forth in the Contract. The Contractor shall be responsible and shall be required to pay any administrative penalties imposed on the owner for actions taken or lack thereof by the Contractor.

E. Work includes any and all selective demolition and protective measures required to access and remove ACM and maintain a safe working environment.

F. All contractors submitting a bid for this work shall visit the work site, attend a pre-bid meeting and walk-through, to be scheduled by the Owner, and be familiar with the work in its entirety. The contractors pre-meeting attendance and bid submission affirms his/her acceptance of the work, site, and building conditions as is.

G. The Supervisor and Asbestos Abatement workers shall be accredited in accordance with EPA regulation 40 CFR Part 763, subpart E, Appendix C; and RIDOH regulations.

H. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the work. Any discrepancies noted shall be brought to the attention of the Owner and Engineer prior to bidding the project.

I. Work includes necessary selective demolition and protective measures required to access and remove ACM and maintain a safe working environment. Asbestos containing materials that would be impacted by selective demolition of wall, ceiling and floor cavities shall be performed within negative pressure enclosure.

J. The abatement contractor shall hold and document daily pre-abatement safety tool box meeting to review safe work practices and emergency communication program for the project. The abatement contractor's supervisor and the consultant's project monitor must also ensure that proper fire extinguishing equipment is present. The supervisor shall be knowledgeable in use of fire extinguishing equipment, and emergency exit plans.

1.5 TESTING LABORATORY SERVICES

A. The Contractor shall submit to the Consultant the name; address and qualifications of proposed laboratories intended to be utilized for sample analysis as required by this section and the laboratories must be approved by RIDOH.

1.6 ADDITIONAL GENERAL REQUIREMENTS

A. The Asbestos Abatement Contractor shall employ a competent Asbestos Abatement Supervisor with at least three (3) years' experience on projects of similar scope and magnitude who shall be responsible for all work involving asbestos abatement as described

in the specifications and defined in applicable regulations and have full time daily supervision of the same. The Supervisor shall be the competent person as defined by OSHA regulations.

B. The Contractor shall allow the work of this contract to be inspected if required by local, state, federal, and any other authorities having jurisdiction over such work. The Contractor shall immediately notify the Owner and Consultant and shall maintain written evidence of such inspection for review by the Owner and Consultant.

C. The Contractor shall incur the cost of all fines resulting from regulatory non-compliance as issued by federal, state, and local agencies. The Contractor shall incur the cost of all work requirements mandated by federal, state, and local agencies as a result of regulatory non-compliance or negligence.

D. The Contractor shall immediately notify the Owner and Consultant of the delivery of all permits, licenses, certificates of inspection, of approval, or occupancy, etc., and any other such instruments required under codes by authorities having jurisdiction, regardless of who issued, and shall cause them to be displayed to the Owner and Consultant for verification and recording.

1.7 SCOPE OF WORK

A. This specification covers the proper and legal removal and disposal of all asbestos-containing materials (ACM) and asbestos contaminated waste from the building located at 227 Dudley Street, Providence, Rhode Island. The abatement activities shall comply with all aspects of the contract documents and Federal, State and local requirements. There is interior non-friable asbestos containing materials (miscellaneous materials) and friable materials identified on the site. Materials subject to removal are located in the table below.

Material	Location	Quantity	Units
Dark Gray/Black Caulk	Exterior, Base of Building near First Aid	30	LF
Thin Layer Caulk Dark Gray/Brown	Under Aluminum Exterior Windows Frames	16	EA
Dark Gray Black Exterior Window Caulk	Frosted Glass Windows	16	EA
Black Glaze	Exterior Windows w/ Frosted Glass	16	EA
Dark Gray Black Exterior Window Caulk and Glaze	Three Large Windows in Front	3	EA
Dark Gray/Black Glaze	Interior Window on Door to Computer Room	1 (Door)	EA
Floor Mastic	Custodial Closets	50	SF
Remnant Roof Materials	Patches etc.	500	SF

Material	Location	Quantity	Units
Gaskets	On Pipe Connections and Valves	50	EA
ACM Pipe Insulation and Fittings	Behind Fixed Walls/Chases	1,000	LF
Abandoned Steam Boiler and Associated Equipment and Breeching	Pump Room	1	EA

1.8 PROJECT DESCRIPTION

A. The general/abatement contractors shall only use heavy equipment operators that have proper asbestos and/or hazwoper training when disturbing/removing/moving and packing asbestos containing materials. Acceptable training for asbestos can be 32 or 40 hour asbestos worker/supervisor with annual refresher training. 40-hour hazwoper training and annual refresher training is required for operators handling asbestos contaminated materials. All operators must also have current medicals, fit test data and wear respirators during work.

B. The Owner shall retain a Consultant for the purposes of project management and monitoring during asbestos abatement. The Consultant will represent the Owner in all phases of the abatement project at the discretion of the Owner. The asbestos abatement contractor will regard the consultant's direction as authoritative and binding as provided herein, in matters particularly but not limited to approval of work areas, review of monitoring results, completion of the various segments of work, final completion of the abatement, submission of data, and daily field punch list items.

1.9 DEFINITIONS

A. The following definitions relative to asbestos abatement apply:

1. Abatement - Procedures to control fiber release from asbestos-containing materials; includes removal, encapsulation, and enclosure.
2. Air Monitoring - The process of measuring the fiber concentration of an area or of a person.
3. Amended Water - Water to which a surfactant has been added.
4. Asbestos - The name given to a number of naturally occurring fibrous silicates. This includes the serpentine forms and the amphiboles and includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite, or any of these forms, which have been chemically altered.
5. Asbestos Felt - a product made by saturating felted asbestos with asphalt or other suitable bindery, such as a synthetic elastomer.
6. Asbestos Fibers - Those particles with a length greater than five (5) microns and a length to diameter ratio of 3:1 or greater.
7. Asbestos Work Area - a regulated area as defined by OSHA 29 CFR 1926.1101 where asbestos abatement operations are performed which is isolated by physical barriers to prevent the

spread of asbestos dust, fibers, or debris. The regulated area shall comply with requirements of regulated area for demarcation, access, respirators, prohibited activities, competent persons and exposure assessments and monitoring.

8. Caulking - resilient mastic compound often having a silicone bituminous or rubber base; used to seal cracks, fill joints, and prevent leakage. Typical applications: around windows, and doors. Caulking is at joints between two dissimilar materials. (i.e. masonry to wood, masonry to steel)
9. Clean Room - An uncontaminated area or room, which is a part of the worker decontamination enclosure with provisions for storage of workers' street clothes and protective equipment.
10. Clearance Sampling - Final air sampling performed aggressively after the completion of the abatement project in a regulated area.

    Air samples collected by the air sampling professional having a fiber concentration of less than 0.01 fibers/cc of air in each of five (5) samples collected inside the containment will denote acceptable clearance sampling by Phase Contrast Microscopy.
    or
    Five air samples collected inside the containment by the air sampling professional having an average asbestos concentration of less than 70 structures per square millimeter of air will denote acceptable clearance sampling for Transmission Electron Microscopy.
11. Competent Person - As defined by 29 CFR 1926.1101, a representative of the Abatement Contractor who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure. Who has authority to take prompt corrective measures to eliminate such hazards during asbestos removal. Competent person shall be properly trained in accordance with EPA's Model Accreditation Plan.
12. Curtained Doorway - A device to allow ingress and egress from one area to another while permitting minimal air movement between the areas. Two curtained doorways spaced a minimum of six feet apart can form an airlock.
13. Damp Proofing - application of a water impervious material to surface such as wall to prevent penetration of moisture, typically at foundation or below grade surface.
14. Decontamination Enclosure System - A series of connected areas, with curtained doorways between any two adjacent areas, for the decontamination of workers and equipment. A decontamination enclosure system always contains at least one airlock and is adjacent and connected to the regulated area, where possible.
15. Encapsulant - A liquid material which can be applied to asbestos-containing materials which controls the possible release of asbestos fibers from the materials either by creating a membrane over the surface (bridging encapsulant) or penetrating the material and binding its components together (penetrating encapsulant).
16. Equipment Room - Any contaminated area or a room that is part of the worker decontamination enclosure with provisions for storage of contaminated clothing and equipment.
17. Fixed Object - Unit of equipment or furniture in the work areas that cannot be removed from the work area.
18. Friable Asbestos Materials - Any material that contains more than 1% asbestos by weight, that can be crumbled, pulverized or reduced to powder by hand pressure.
19. Glazing Compound - any compound used to hold window glass in place, also referred to as putty, or glazier's putty, is not field applied, usually installed during manufacture of windows.
20. Hepa Filter - High Efficiency Particulate Air (HEPA) filter in compliance with ANSI Z9.2-1979.

21. Hepa Vacuum Equipment - Vacuum equipment equipped with an I IEPA filter system for filtering the effluent air from the unit.
22. Movable Object - Unit of equipment of furniture in the work area that can be removed from the work area.
23. Negative Air Pressure Equipment - A portable local exhaust system equipped with HEPA filtration used to create negative pressure in a regulated area (negative with respect to adjacent unregulated areas) and capable of maintaining a constant, low velocity air flow into regulated areas from adjacent unregulated areas.
24. NESHAPS - National Emissions Standard for Hazardous Air Pollutants regulations enforced by the EPA.
25. Permissible Exposure Level (PEL) - The maximum airborne concentration of asbestos fibers to which an employee is allowed to be exposed. The new level established by OSHA 29 CFR 1926.1101 is 0.1 fibers per cubic centimeter of air as an eight (8) hour time weighted average and 1.0 fibers /cc averaged over a sampling period of 30 minutes as an Excursion Limit. The Contractor is responsible for maintaining work areas in a manner that this standard is not exceeded.
26. Project Monitor - A professional capable of conducting air monitoring and analysis of schemes. This individual should be an industrial hygienist, an environmental scientist, or an engineer with experience in asbestos air monitoring and worker protection equipment and procedures. This individual should have demonstrated proficiency in conducting air sample collection in accordance with 29 CFR 1910.1001 and 29 CFR 1926.1101.
27. Regulated Area - An area established by the employer to demarcate where Class I, II, and III asbestos work is conducted and any adjoining area where debris and waste from such asbestos work accumulate, and a work area within which airborne concentrations of asbestos exceed or there is a reasonable possibility that they may exceed the PEL.
28. Shower Room - A room between the clean room and the equipment room in the work decontamination enclosure with hot and cold running water and suitably arranged for employee showering during decontamination. The shower room is located in an airlock between the contaminated area and the clean area.
29. Waterproofing - material, usually a membrane or applied compound (tar/mastic), used to make a surface impervious to water, includes concealed conditions (applications around doors, windows, and in wall cavities). Sometimes combined with felts.

1.10 SUBMITTALS

A. Pre-Work Submittals: Within 7 days prior to the pre-construction conference, the Contractor shall submit 3 copies of the documents listed below to the Owner and Engineer for review:

1. Valid Contractor's Asbestos Removal license issued by the Rhode Island Department of Health (RIDOH).
2. Certificate of insurance covering work of this Contract.
3. Name, experience of supervisors, and copies of valid Asbestos Supervisor permits issued by the RIDOH.
4. Project Notifications: As required by Federal, State, and local regulatory agencies together with proof of transmittal (i.e. certified mail return receipt). The contractor shall notify the Rhode Island Department of Public Health and US EPA Region 1 at least ten (10) days prior to the start of asbestos abatement, as required by the Regulations of Rhode Island State Agencies, and EPA.

5. Abatement Work Plan: The Contractor shall design, prepare and submit to the Authority for review and approval, a detailed asbestos removal plan for the project in accordance with the applicable regulations and these specifications. The plan shall, at minimum, show limits of containment and work areas, methods of removal, location of decontamination units, number and location of negative air units, waste routes, waste storage location, entrance and exits, emergency exits, and any necessary details. Work shall not commence until the Authority has reviewed, commented and approved the contractor's asbestos removal plan. Provide plans which clearly indicate the following:

    a. All Work Areas/containment numbered sequentially.
    b. Locations and types of all decontamination enclosures.
    c. Entrances and exits to the Work Areas/containment.
    d. Type of abatement activity/technique for each Work Area/containment.
    e. Number and location of negative air units and exhaust. Also provide calculations for determining number of negative air pressure units.
    f. Proposed location and construction of storage facilities and field office.
    g. Location of water and electrical connections to building services.
    h. Waste transport routes through the building to the waste storage container.

6. Contingency plan.
7. Name, location, and applicable licenses for primary and secondary landfill for disposal of asbestos-containing material and asbestos contaminated waste.
8. Summary of proposed materials, and equipment to be used.
9. Certification that vacuums, temporary ventilation equipment, and other equipment to be used meet the ANSI 29.2-79 requirement for airborne fiber filtration.
10. If rental equipment is to be used in work area or to transport asbestos contaminated waste, provide notice to rental agency stating intended use of equipment, with copy to the Authority.
11. Summary of the Contractor's workforce by disciplines. Include a notarized statement signed by the Contractor documenting that all proposed workers, by name, have received all required medical examinations and have been properly trained and certified in asbestos removal work, respirator use, to appropriate EPA and OSHA standards for asbestos removal. Include on statement Contractor's compliance with OSHA medical surveillance requirements.
12. The Contractor shall submit his/her Health and Safety Plan and Standard Operating Procedures for this project for use in complying with the requirements of these Specifications and applicable regulations. The Plan shall include, but shall not be limited to: distribution and use of amended water, the sequencing of asbestos work, detailed schedules and dates, shift times, and work activities during that shift, the interface of other trades involved in the performance of work, methods to be used to assure the safety of building occupants and visitors to the Site, security of the work areas, and a detailed description of the methods to be employed to control airborne fiber concentrations.
13. Written description of emergency procedures to be followed in case of injury or fire. This section must also include evacuation procedures, sources of medical assistance and procedures for access by medical personnel.
14. Level of respiratory protection intended for each operation for the project.

B. Project Closeout Submittals: Submit the following to Owner and Consultant at the close out of the Project (no later than 15 days subsequent to site demobilization):

1. Originals of all waste disposal manifests, seals, and disposal logs.
2. OSHA compliance air monitoring records conducted during the work.
3. Daily progress log.

a. A list of all workers used in the performance of the Project, including name, social security number, and RIDOH certification number.
b. For each worker used in the performance of the project, submit required employee statements including Medical Examination Statement, Worker's Acknowledgment Statement, Respirator Fit Test, and Employee Training Statement.
c. Certification for the laboratory that analyzed the OSHA personnel air samples.
d. A notarized "Release of Liens" in a form acceptable to the owner. Such notarized release of liens shall certify that all sub-contractors, labor suppliers, etc. have been paid their pro rate share of all payments to date for the project, that the contractor has no basis for further claims, and will not make further claims for payment in any account after the first payment is made to him.

1.11 MEDICAL REQUIREMENTS

A. Prior to potential exposure to airborne asbestos fibers, provide workers with a comprehensive medical examination as required by 29 CFR 1910.1001, and 29 CFR 1926.1101.

1. This examination is not required if adequate records show the employee has been examined as required by 29 CFR 1910.1001, and 29 CFR 1926.1101 within the past year.
2. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos fibers and within thirty (30) calendar days before or after the termination of employment in such occupations.

B. As required by 29 CFR 1910.1001, and 29 CFR 1926.1101 maintain complete and accurate records of employees' medical examinations for a period of thirty (30) years after termination of employment and make records of the required medical examinations available for inspection and copying to: The Assistant Secretary of Labor for Occupational Safety and Health, the Director of the National Institute for Occupational Safety and Health (NIOSH), authorized representatives of either of them, and an employee's physician upon the request of the employee or former employee.

C. The Contractor shall furnish the Owner evidence of its firm's medical surveillance program required under 29 CFR 1910.1001, and 29 CFR 1926.1101.

1.12 REGULATIONS AND STANDARDS

Regulatory compliance includes but is not necessarily limited to applicable requirements set forth by:

A. Federal Regulations:

1. 29 CFR 1910 and 1926 – Construction and General Industry Standards
2. 29 CFR 1910.1001, "Asbestos" (OSHA)
3. 29 CFR 1910.1200, "Hazard Communication" (OSHA)
4. 29 CFR 1910.134, "Respiratory Protection" (OSHA)
5. 29 CFR 1910.145, "Specification for Accident Prevention Signs and Tags" (OSHA)

6. 29 CFR 1910.146, “Permit Required Confined Spaces” (OSHA)
7. 29 CFR 1926, "Construction Industry" (OSHA)
8. 29 CFR 1926.1101, "Asbestos, Tremolite, Anthophyllite, and Actinolite" (OSHA)
9. 29 CFR 1926.500 "Guardrails, Handrails and Covers" (OSHA)
10. 40 CFR 61, Subpart A, "General Provisions" (EPA)
11. 40 CFR 61, Subpart M, "National Emission Standards for Hazardous Air Pollutants (NESHAP)" (EPA)
12. 40 CFR 763 Subpart E, “Asbestos in Schools Regulations” (EPA)
13. 49 CFR 171-172, Transportation Standards (DOT)

B. Rhode Island Regulations:

State requirements which govern asbestos abatement work and hauling and disposal of asbestos waste materials include but are not necessarily limited to the following:

1. Rhode Island Department of Energy and Environmental Protection (Solid Waste Management Regulations).
2. Rhode Island Department of Public Health (RIDOH) regulations for Asbestos Abatement.

C. Local Regulations:

Local agencies which may govern or have certain requirements regarding asbestos abatement work or hauling and disposal of asbestos waste materials include but are not necessarily limited to the following:

1. Building Department
2. Health Department
3. Fire Department

D. Standards and Guidance Documents:

1. American National Standard Institute (ANSI) Z88.2-80, Practices for Respiratory Protection
2. ANSI Z9.2-79, Fundamentals Governing the Design and Operation of Local Exhaust Systems
3. EPA 560/585-024, Guidance for Controlling Asbestos Containing Materials in Buildings (Purple Book)
4. EPA 530-SW-85-007, Asbestos Waste Management Guidance

1.13 EXEMPTIONS

A. Any deviations from these specifications require the written approval and authorization from the Owner and Consultant.

B. Any modifications from the standard work practices identified in the RIDOH Standards for Asbestos Abatement.

1.14 FINAL AIR CLEARANCE

A. Following the completion of the encapsulation phase of the work, the Consultant shall

collect final air clearance samples inside the work area per AHERA regulation 40 CFR Part 763 and in compliance with RIDOH regulations.

1.15 WORK SITE SAFETY PLAN

A. The contractor shall establish a set of emergency procedures and shall post them in a conspicuous place at the work site. The safety plan should include provisions for the following:

1. Evacuation of injured workers.
2. Emergency and fire exit routes from all work areas.
3. Emergency first aid treatment
4. Local telephone numbers for emergency services including ambulance, fire, and police.
5. A method to notify occupants of the building in the event of a fire or other emergency requiring evacuation of the building.

B. The contractor is responsible for training all workers in these procedures.

1.16 INDEPENDENT AIR SAMPLING AND ASBESTOS ABATEMENT MONITORING

A. This section describes independent air sampling work being performed on behalf of the Owner. This work is not in the Contract Sum. This section describes air monitoring carried out by the Owner's Consultant to verify that the building beyond the work area and the outside environment remains uncontaminated. (Personal air monitoring required by OSHA is work to be performed by the Contractor and is within the Contract Sum.)

B. The purpose of the Owner's Consultant's air monitoring is to detect faults in the work are isolation such as:

1. Contamination of the building outside of the work area by airborne asbestos fibers.
2. Failure of filtration or rupture in the differential pressure system.
3. Contamination of air outside the building envelope by airborne asbestos fibers. Should any of the above occur the Contractor shall immediately cease asbestos abatement activities until the fault is corrected. Do not recommence work until authorized by the Owner's Consultant.

C. The Owner's Consultant will monitor airborne fiber counts in the Work Area. The purpose of this air monitoring will be to detect airborne asbestos concentrations, which may challenge the ability of the Work Area isolation procedures to protect the balance of the building or outside of the building from contamination by airborne fibers.

D. To determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to an acceptable level, the Consultant will sample and analyze air in accordance with clearance air sampling requirements.

E. The Owner's Consultant will perform on-site monitoring throughout the course of the project, as follows:

1. All work procedures shall be continuously monitored by the Consultant to assure that areas outside the designated work locations in the buildings will not be contaminated.
2. Prior to work on any given day, the Contractor's designated "competent person" shall discuss the day's work schedule with the Consultant to evaluate job tasks with respect to safety procedures and requirements specified to prevent contamination of the building or the employees. This includes a visual survey of the work area and the decontamination of

the building or the employees. This includes a visual survey of the work area and the decontamination enclosure systems.

1.17 CONTRACTOR'S AIR SAMPLING RESPONSIBILITY

A. The contractor shall independently retain a RI licensed asbestos project monitor to monitor airborne asbestos concentrations in the workers' breathing zone and to establish
B. conditions and work procedures for maintaining compliance with OSHA Regulations 29 CFR 1910.1001 and 1926.1101.

C. The Contractor's project monitor shall document all air sampling results and provide a report to the Consultant within 24 hours after sample collection.

D. All air sampling shall be conducted in accordance with methods described in OSHA Standards 29 CFR 1910.1001 and 1926.1101 and the OSHA Respiratory Protection Standard 29 CFR 1910.134.

E. A minimum of 20% of all workers in each working category (i.e., gross removal, final clearance, etc.) must be monitored each day of asbestos removal activities.

F. Phase Contrast Microscopy may be used to analyze personal air samples. The Contractor shall arrange and pay for all costs of the testing. Laboratories used shall be currently enrolled in the American Industrial Hygiene Association Proficiency Analytical Testing Program or an equivalent recognized program and approved by RIDOH.

1.18 PROPER WORKER PROTECTION

A. This section describes the equipment and procedures required for protecting workers against asbestos contamination and other workplace hazards except for respiratory protection.

B. All workers are to be accredited as abatement workers as required by the AHERA regulation 40 CFR 763 Appendix C to Subpart E, February 3, 1994.

C. The contractor is required to be certified and accredited as required by the State of Rhode Island Department of Public Health Services.

D. In accordance with 29 CFR 1926 and 20-440-7 RCSA, all workers shall receive a training course covering the dangers inherent in handling asbestos, the dangers of breathing asbestos dust, proper work procedures, and proper worker protective measures. This course must include but is not limited to the following:

1. Methods of recognizing asbestos
2. Health effects associated with asbestos
3. Relationship between smoking and asbestos in producing lung cancer
4. Nature of operations that could result in exposure to asbestos
5. Importance of and instruction in the use of necessary protective controls, practices and procedures to minimize exposure including:

    a. Engineering controls
    b. Work Practices
    c. Respirators
    d. Housekeeping procedures
    e. Hygiene facilities

f. Protective clothing
g. Decontamination procedures
h. Emergency procedures

6. Waste disposal procedures
7. Purpose, proper use, fitting, instructions, and limitations of respirators as required by 29 CFR 1910.134
8. Appropriate work practices for the work
9. Requirements of medical surveillance program
10. Review of 29 CFR 1926
11. Pressure Differential Systems
12. Work practices including hands on or on-job training
13. Personal Decontamination procedures
14. Air monitoring, personal and area

E. The Contractor shall provide medical examinations for all workers who may encounter an airborne fiber level of 0.1 f/cc or greater for an 8-hour Time Weighted Average and/or enter regulated areas. In the absence of specific airborne fiber data provide medical examinations for all workers who will enter the Work Area for any reason. Examination shall, at a minimum, meet OSHA requirements as set forth in 29 CFR 1926 In addition, provide an evaluation of the individual's ability to work in environments capable of producing heat stress in the worker.

F. Submit certification signed by an officer of the abatement-contracting firm and notarized that exposure measurements, medical surveillance, and worker training records are being kept in conformance with 29 CFR 1926.

G. The Contractor shall maintain control of and be responsible for access to all work areas to ensure the following requirements:

1. Non-essential personnel are prohibited from entering the area.
2. All authorized personnel entering the work area shall read the "Worker Protection Procedures" which are posted at the entry points to the enclosure system, and shall be equipped with properly fitted respirators and protective clothing.
3. All personnel who are exiting from the decontamination enclosure system shall be properly decontaminated.
4. Asbestos waste that is taken out of the work area must be properly bagged and labeled in accordance with these specifications. The surface of the bags shall be decontaminated. Asbestos leaving the enclosure system must be immediately transported off-site or immediately placed in locked, posted temporary storage on-site, and removed within 24 hours of the project conclusion.
5. Any material, equipment, or supplies that are brought out of the decontamination enclosure system shall be cleaned and decontaminated by wet cleaning and/or HEPA vacuuming of all surfaces.

1.19 ALTERNATE WORK PRACTICES

A. The contractor and/or consultant may obtain services of a RIDOH certified asbestos project designer and submit application for variances to the RIDOH, as applicable for any alterations, modifications or non-conforming methods intended of asbestos removal. Methods requiring variances include but are not necessarily limited to glove-bagging, use

of tent procedures, remote decons, etc. The alternative procedures shall be submitted in writing and hand delivered or post marked at least ten (10) days before the project start date. RIDOH may approve an alternative procedure for an asbestos abatement project with certain conditions that would provide equivalent or a greater measure of asbestos emission control than the conventional work practices. The alternate work practice request form shall be signed and sealed by a Licensed Designer. Any fees associated with the application shall be paid by the Contractor.

1.20 POST-PROJECT CLOSEOUT

A. The contractor shall provide all required documentation as required by this specification once his/her work is complete, final clearances passed and asbestos waste disposed of. This should include but not be limited to: bound copy of the daily log containing log of daily work activities, all supervisor and worker certificates of training and Rhode Island licenses, certificates of insurance, daily sign in sheets, containment entry/exit logs, copy of recording manometer charts, waste shipment records, personal air monitoring laboratory reports and chain-of-custody documentation, and project completion certificate. Final payment shall not be made to the contractor until all required documentation is submitted and verified.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Deliver all materials in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name and product technical description.

B. Damaged or deteriorating materials shall not be used and shall be removed from the premises. Material that becomes contaminated with asbestos shall be decontaminated or disposed of as asbestos waste.

C. Polyethylene sheet in a roll size to minimize the frequency of joints shall be delivered to the job site with factory label indicating 4 or 6 mil.

D. Polyethylene disposable bags shall be six (6) mil with pertinent pre-printed label. Tie wraps for bags shall be plastic, five (5) inches long (minimum), pointed and looped to secure filled plastic bags.

E. Tape or adhesive spray will be capable of sealing joints in adjacent polyethylene sheets and for attachment of polyethylene sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under both dry and wet conditions, including use of amended water.

F. Surfactant (wetting agent), shall consist of fifty (50) percent polyoxyethylene ether and fifty (50) percent polyoxyethylene ester, or equivalent, and shall be mixed with water to provide a concentration of one (1) ounce surfactant to five (5) gallons of water or as directed by manufacturer.

G. Removal encapsulant shall be non-flammable factory prepared penetrating chemical encapsulant found acceptable to Consultant. Usage shall be in accordance with manufacturer's printed technical data.

H. The contractor shall have available spray equipment capable of mixing wetting agent with water and capable of generating sufficient pressure and volume and having sufficient hose length to reach all areas with asbestos.

I. Impermeable containers are to be used to received and retain any asbestos-containing or contaminated materials until disposal at an acceptable disposal site. The containers shall be

labeled in accordance with OSHA Standard 29 CFR 1926.1101. Containers must be both air and watertight.

J. Labels and signs, as required by OSHA Standard 29 CFR 1926.1101, will be used.

K. Encapsulant shall be bridging or penetrating type which has been found acceptable to the consultant. Usage shall be in accordance with manufacturer's printed technical data.

L. HEPA filtered local exhaust ventilation shall be utilized during the installation of enclosures and supports where asbestos-containing materials may be disturbed.

2.2 TOOLS AND EQUIPMENT

A. The contractor shall provide all tools and equipment necessary for asbestos removal, encapsulation and enclosure.

B. The contractor's air monitoring professional shall have air-monitoring equipment of type and quantity to monitor operations and conduct personnel exposure surveillance per OSHA requirements.

C. The contractor shall have available sufficient inventory or dated purchase orders for materials necessary for the job including protective clothing, respirators, filter cartridges, polyethylene sheeting of proper size and thickness, tape and air filters.

D. The contractor shall provide (as needed) temporary electrical power panels, electrical power cables, and electrical power sources (such as generators). Any electrical connection work affecting the building electrical power system shall be performed by a State of Rhode Island licensed electrician and the contractor shall obtain all necessary local permits.

E. The contractor shall have available shower stalls and plumbing to support same to include sufficient hose length and drain system or an acceptable alternate.

F. Exhaust air filtration system units shall contain HEPA filter(s) capable of sufficient air exhaust to create negative pressure of -0.02 inches of water within enclosure with respect to outside area. Equipment shall be checked for proper operation by smoke tubes or differential pressure gauge before the start of each shift and at least twice during the shift. Adequate exhaust air shall be provided for a minimum of four (4) air changes per hour within the enclosure. No air movement system or air filtering equipment shall discharge unfiltered air outside.

G. Vacuum units, of suitable size and capacities for the project, shall have HEPA filter(s) capable of trapping and retaining at least 99.97 percent of all monodispersed particles of 0.3 micrometers in diameter or larger.

H. The contractor will have reserve units so that systems will operate continuously.

2.3 RESPIRATORY PROTECTION

A. Select respirators from those approved by the Mine Safety and Health Administration (MSHA), and the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

B. Respirators shall be individually fit-tested to personnel under the direction of an Industrial Hygienist on a yearly basis. Fit-tested respirators shall be permanently marked to identify the individual fitted, and use shall be limited to that individual. Fit-test records shall be maintained on-site for each employee.

C. Where fiber levels permit, and in compliance with regulatory requirements, Powered Air Purifying Respirators (PAPR) are the minimum allowable respiratory protection permitted to be utilized during gross removal operations. The Contractor shall use supplied air respirator for confined space requirements. PAPR's are the minimal respiratory protection required for all thermal system insulation and surfacing asbestos abatement.

D. No respirators shall be issued to personnel without such personnel participating in a respirator training program.

E. High Efficiency Particulate Air (HEPA) respirator filters shall be approved by NIOSH and shall conform to the OSHA requirements in 29 CFR 1910.134 and 29 CFR 1926.1101.

F. A storage area for respirators shall be provided by the contractor in the clean room side of the personnel decontamination enclosure where they will be kept in a clean environment.

G. The contractor shall provide and make available a sufficient quantity of respirator filters so that filter changes can be made as necessary during the work day. Filters will be removed and discarded during the decontamination process. Filters cannot be reused. Filters must be changed if breathing becomes difficult.

H. Filters used with negative pressure air purifying respirators shall not be used any longer than one eight (8) hour work day.

I. Any authorized visitor, worker, or supervisor found in the work area not wearing the required respiratory protection shall be removed from the project site and not be permitted to return.

J. The contractor shall have at least two (2) Powered Air Purifying Respirators stored on- site designated for authorized visitors use. Appropriate respirator filters for authorized visitors shall be made available by the contractor.

K. Establish a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134, and 29 CFR 1926.1101. Provide respirator training and fit-testing.

2.4 PROTECTIVE CLOTHING

A. Provide personnel utilized during the Project with disposable protective whole-body clothing, head coverings, gloves and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may also be worn. Make sleeves secure at the wrists and make foot coverings secure at the ankles by the use of tape or provide disposable coverings with elastic wrists or tops.

B. Provide sufficient quantities of protective clothing to assure a minimum of four (4) complete disposable outfits per day for each individual performing abatement Work.

C. Eye protection and hard hats shall be provided and made available for all personnel entering any work area.

D. Authorized visitors shall be provided with suitable protective clothing, headgear, eye protection, and footwear whenever they enter the work area.

PART 3 - EXECUTION

3.1 WORK AREA PREPARATION

A. Where necessary, shut down electrical power, including receptacles and light fixtures. Under no circumstances during the decontamination procedures will lighting fixtures be permitted to be operating when the spraying of amended water may contact the fixture. Provide GFCI devices, temporary power, and temporary lighting installed in compliance with the applicable electrical codes. All installations are to be made by a State of Rhode Island licensed electrician.

B. Shut down and/or isolate heating, cooling, and ventilation air systems or zones to prevent contamination and fiber dispersal to other areas of the structure. During the work, vents within the work area shall be sealed with duct tape and polyethylene sheeting.

C. The contractor shall be responsible for removing furniture from the work areas. The contractor shall pre-clean moveable objects within the proposed work areas using HEPA vacuum equipment and/or wet cleaning methods as appropriate and remove such objects from work areas to a temporary location. For example, cabinets to gain access to floor tile and associated mastic.

D. Seal off all openings, including, but not limited to, windows, corridors, doorways, skylights, ducts, grills, diffusers, and any other penetration of the work areas, with polyethylene sheeting a minimum of six (6) mils thick, sealed with duct tape. This includes doorways and corridors that will not be used for passage during work areas and occupied areas.

E. Pre-clean fixed objects within the work areas, using HEPA vacuum equipment and/or wet cleaning methods as appropriate, and enclose with a minimum six (6) mil plastic sheeting sealed with duct tape.

F. Clean the proposed work areas using HEPA vacuum equipment or wet cleaning methods as appropriate. Do not use methods that raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters.

G. After HEPA vacuum cleaning, cover fixed walls with two (2) layers of four (4) mil polyethylene sheeting to the floor level. Where fixed walls are not used, two layers of six

H. (6) mil polyethylene sheeting will be applied to a rigid framework of wood, metal, or PVC. Where floor tile/mastic is not being abated, cover the floor with two (2) layers of six-mil polyethylene sheeting. All overlaps shall be sealed with tape or spray adhesive.

I. Maintain emergency and fire exits from the work areas, or establish alternate exits satisfactory to fire officials.

J. Clean and remove ceiling mounted objects, such as lights and other items not sealed off, which interfere with asbestos abatement. Use hand-held amended water spraying or HEPA vacuuming equipment during fixture removal to reduce settled fiber dispersal.

K. Create pressure differential between work areas and uncontaminated areas by the use of acceptable negative air pressure equipment sufficient to provide four (4) air changes per hour and create negative pressure of -0.02 inches of water within enclosure with respect to outside area as measured on a water gauge.

3.2 DECONTAMINATION SYSTEM

A. The following requirements shall be followed for the worker decontamination unit:

1. At all asbestos abatement projects, work areas shall be equipped with decontamination facilities consisting of: a clean room, a shower room, and an equipment room attached to

each containment.

2. The decontamination enclosure system chambers shall be constructed to meet the criteria of the Specification. The decontamination enclosure shall be installed watertight to prevent water leaks. The interior shall be lined with two layers of 6-mil fire-retardant plastic sheeting, with a minimum overlap of 16 inches at seams and sealed (airtight) by tape and adhesive. The interior floor shall be sheathed with (2) layers of reinforced fire retardant plastic sheeting with a minimum overlap on the wall of sixteen (16) inches. The contractor shall ensure compliance with local building codes and other regulations governing temporary structures.
3. Curtained Doorways: Three overlapping sheets of 6-mil polyethylene shall be placed over a framed doorway and secured along the top of the doorway. Secure the vertical edge of the outer sheets along one vertical side of the doorway and the vertical edge of the center sheet along the opposite vertical side of the doorway. The sheets shall be weighted so that they close quickly after being released.
4. Air Locks: Air locks shall consist of two curtained doorways placed a minimum of three feet apart.

    a. Clean Room: In this room, persons remove and leave all street clothes and put on clean disposable coveralls. Approved respiratory protection equipment is stored in this area. The floor of the clean room must be kept dry at all times. At the end of each shift, the room must be cleaned using wet rags. Also, a lockable door may be installed. No asbestos-containing materials are allowed in this room. The clean room shall be equipped with suitable hooks, lockers, shelves, etc. for workers to store personal articles and clothing. THIS IS NOT A CONTAMINATED AREA.
    b. Shower Room: Provide a completely watertight operational shower to be used by cleanly dressed workers heading for the Work area from the clean room or for showering workers headed out of the Work Area after dressing in the Equipment Room. Shower must be constructed so that water leakage is minimized. The shower shall have one shower per six full shift abatement people, calculated on the basis of the largest shift. Any leaking water must be cleaned immediately. Showers must be equipped with hot and cold running water, soap and sufficient disposable towels for the number of workers at the job site. Arrange water shut off and drain pump operation controls, so that a single individual can shower without assistance from either inside or outside the work area. THIS IS A CONTAMINATED AREA.

        Pump wastewater into a polyethylene lined 55-gallon drum located in the work area to be added to the asbestos waste. If the water is allowed by the

        work treatment workers to be pumped into a drain, provide 20 micron and 5 micron waste water filters in line to drain. Change filters at a minimum of once a day. Locate filters inside the shower unit, so that the shower pan catches the water lost during filter change.
    c. Equipment Room: Work equipment, footwear, and all other contaminated work clothing are to be left here upon exiting work area. A walk-off pan filled with water shall be located in the work area just outside the equipment room for workers to clean foot coverings while exiting the work area. This is a change and transit area for workers. Provide a drop cloth layer of sheet plastic on the floor of the Equipment Room for every shift change. Roll drop cloth layer in upon itself at the end of each shift and dispose of as contaminated waste. THIS IS A CONTAMINATED AREA.

        Each room shall be separated from the other and from the work area by airlocks such as will prevent the free passage of air or asbestos fibers and shall be accessible through

doorways protected with three (3) overlapping 6 mil polyethylene sheets which shall be weighed, so as to fall into place when people pass through the area. The shower room shall be contiguous to the clean room and equipment room. All personnel entering or leaving the work area shall pass through the shower room. The number of showers provided shall satisfy the requirements of OSHA 29 CFR 1910.141. Hot and cold water shall be supplied to the showers. The equipment room (dirty room) shall be situated between the shower room and the work area and separated from both by means of suitable barriers or overlapping flaps such as will prevent the free passage of air or asbestos fibers.

Decontamination chamber doors shall be of sufficient height and width to enable replacement of equipment, which may fall, and to safely stretcher or carry an injured worker from the site without destruction of the chamber or unnecessary risk to the integrity of the work area. Such doors must be at least four (4) feet wide, and the distance between sets of doors must be at least four
(4) feet.

5. No person or equipment shall leave the asbestos abatement project work area unless first decontaminated by showering, wet washing or HEPA vacuuming to remove all asbestos debris. No asbestos contaminated materials or persons shall enter the clean room.
6. Where feasible, decontamination systems shall abut the work area. In situations where it is not possible, due to unusual conditions, to establish decontamination systems contiguous to the work area, personnel shall be directed to remove visible asbestos debris from their persons by HEPA-filtered vacuuming prior to donning clean disposable coveralls while still in the work area, and proceeding directly to a remote decontamination system to shower and change clothes to follow work area exit procedures.
7. In specific situations where the asbestos contractor determines that it is not feasible to establish a contiguous decontamination system at a work site, the asbestos contractor shall utilize a remote decontamination system. Such systems must be operated in conformance with 29 CFR 1926.1101, Appendix F.

B. Remote Decontamination Facility:

For exterior work on the roof, glove bag or tent procedures, when full containment enclosure is not feasible, the Contractor shall provide remote personnel decontamination enclosure system if approved by the Consultant.

C. Occupied areas and/or building space not within the work areas shall be separated from asbestos abatement work areas by means of airtight barriers.

D. Construct the decontamination system with wood or metal framing, 3/8" sheathing and cover both sides with a double layer of six (6) mil polyethylene sheeting, spray glued or taped at the joints. Caulk joints watertight at floor, walls, and ceiling.

E. The contractor and the consultant shall visually inspect barrier several times daily to assure effective seal and the contractor shall repair defects immediately

F. Waste/Equipment Decontamination Enclosure System:

G. This system is located adjacent to the work area. The equipment decontamination enclosure system, consisting of two totally enclosed spaces, shall be constructed as follows:

1. Equipment Washroom: An equipment washroom shall have two air locks: one adjacent to

the work area and one common air lock which separate it from the holding area. The washroom shall have facilities for washing material containers and equipment. Gross removal of dust and debris from contaminated material containers and equipment shall be accomplished in the work area, prior to moving to the washroom.

2. Holding Area: A holding area shall share a common air lock with the equipment washroom and shall have a curtained doorway to outside areas. A hinged, lockable door shall be placed at the holding area entrance to prevent unauthorized access into the work area.
3. Remote Decontamination Facility: For exterior work on the roof, glove bag or tent procedures, when full containment enclosure is not required, the contractor shall provide remote Waste/Equipment decontamination enclosure system as specified.

3.2 ABATEMENT REMOVAL PROCEDURES

A. Regulatory compliance will include, but is not necessarily limited to, applicable requirements set forth by the Federal Environmental Protection Agency (EPA), Rhode Island Departments of Public Health (RIDOH), Rhode Island Department of Environmental Protection, and local Health and Building Departments.

B. The following procedures shall be followed while performing the abatement activities:

1. No asbestos abatement work, including preparation, shall be performed or continued without having proper notification and a certified supervisor at the work area. The contractor shall have a designated "competent person" on the job at all times to ensure establishment of a proper enclosure system and proper work practices throughout the project.
2. Abatement work will not commence until authorized by the consultant.
3. Provide and display danger signs at every entrance to the work areas in clearly visible locations indicating that asbestos removal work is being conducted and unauthorized and not protected persons should not enter.
   Signs must use the following legend:

   DANGER
   ASBESTOS
   MAY CAUSE CANCER CAUSES
   DAMAGE TO LUNGS
   AUTHORIZED PERSONNEL ONLY
   WEAR RESPIRATORY PROTECTION AND
   PROTECTIVE CLOTHING IN THIS AREA

   Signs shall be posted which meet the specifications set forth in 29 CFR 1926.1101 at all approaches to the work area. Signs shall be posted a sufficient distance from the work area to permit a person to read the sign and take precautionary measures to avoid exposure to asbestos.

4. The worker decontamination enclosure system shall be installed or constructed prior to plasticizing the work area or before disturbing ACM. The waste decontamination enclosure system shall be installed or constructed prior to commencement of gross removal work.
5. All asbestos handlers shall wear disposable suits, including gloves, hood and footwear, and appropriate respiratory equipment, after removing street clothes in the clean room.
6. Abatement of asbestos-containing materials shall be done by wet methods only.
7. ACM shall be sprayed with amended water in sufficient frequency and quantity for

enhanced penetration. Sufficient time shall be allowed for penetration to occur prior to removal action or other disturbance taking place. Dry removal of asbestos materials is prohibited.

8. In order to maintain indoor asbestos concentrations to the minimum, the wet asbestos must be removed in manageable sections. Material drop shall not exceed eight (8) feet. For heights up to 15 feet, provide inclined chutes or scaffolding to intercept drop.
9. Remove asbestos containing materials as appropriate by standard methods. Fill disposal containers as removal proceeds; seal filled containers and clean containers before removal to equipment decontamination system. Wet clean each container thoroughly, double bag and apply caution label. Ensure that workers do not exit the work area thorough the equipment decontamination enclosure.
10. After completion of stripping work, all surfaces from which asbestos has been removed shall be wet brushed, using a nylon brush, wet wiped, and sponged or cleaned by an equivalent method to remove all visible material (wire brushes are not permitted). During this work, the surfaces being cleaned shall be kept wet.
11. Remove and containerize all visible accumulations of asbestos-containing and/or asbestos-contaminated debris. During cleanup, utilize brooms, rubber dustpan, and rubber squeegees to minimize damage to floor covering.
12. Retrieve all free water in contaminated areas and place in plastic lined leak-tight drums.
13. Sealed disposal containers, and all equipment used in the work area, shall be included in the cleanup and shall be removed from work areas via the equipment decontamination enclosure at an appropriate time in the cleaning sequence. All asbestos waste in 6-mil polyethylene disposal bags shall be double bagged in the equipment decontamination enclosure before removal from the Site.
14. At any time during asbestos removal, should the consultant suspect contamination of areas outside the work area(s), he shall cause all abatement work to stop until the contractor takes steps to decontaminate these areas and eliminate the causes of such contamination. Unprotected individuals shall be prohibited from entering suspected contaminated areas until air sampling and visual inspections certify decontamination.
15. After completion of the initial final cleaning procedure including removal of the inner layers of polyethylene sheeting, but prior to encapsulation, a pre-sealant inspection shall be conducted by the consultant. The pre-sealant inspection shall verify that ACM and residual dust has been removed from the work area.
16. After the work area has been inspected by the Engineer and rendered free of visible debris, a thin coat of a pigmented (non-transparent) encapsulating agent shall be applied to all surfaces in the work area from which ACM was removed, to lockdown nonvisible fibers.
17. Removal of asbestos containing materials shall be done under negative pressure containment. All OSHA Class I, Class III, and interior Class II asbestos abatement projects shall employ HEPA negative air pressure equipment ventilation. The negative air pressure equipment shall operate continuously, twenty-four (24) hours a day, from startup of negative air pressure equipment, through the cleanup operations. A negative air pressure, relative to areas outside of the enclosure, shall be maintained at all times in the regulated abatement work area during the asbestos abatement project to ensure that contaminated air in the regulated abatement work area does not escape back to an uncontaminated area. A manometer shall be used to document the pressure differential for all OSHA Class I Large and Small size asbestos project regulated abatement work areas. A minimum of -0.02 column inches of water pressure differential, relative to pressure outside the regulated abatement work area, shall be maintained within the regulated abatement work area, as evidenced by manometric measurements.

3.3 CONSULTANT'S RESPONSIBILITIES

A. Air sampling shall be conducted by the consultant to ascertain the integrity of controls that protect the building from asbestos contamination. Independently, the contractor shall monitor air quality within the work area to ascertain the protection of employees and to comply with OSHA regulations.

B. The consultant's RIDOH licensed asbestos project monitor shall collect and analyze air samples during two time periods:

1. Abatement Period: If required, the consultant's project monitor shall collect samples on a daily basis during the work period. A sufficient number of area samples shall be taken outside of the work area, at the exhaust of the negative pressure system, and outside of the building to judge the degree of cleanliness or contamination of the building during removal. Additional samples may be taken inside the work area and decontamination enclosure system, at the discretion of the project monitor.

   Post-Abatement Period: The consultant's project monitor shall conduct air sampling following the final cleanup phase of the project, once the "no visible residue" criterion, as established by the project monitor, has been met. Five (5) samples shall be collected inside the work area utilizing aggressive methods to comply with the State of Rhode Island Department of Public Health Standards for Asbestos Abatement, sections 19a-332a-12. Analysis of the samples to determine airborne concentrations of asbestos shall be conducted by Transmission Electron Microscopy (TEM) method with an average limit of 70.0 structures per square millimeter of filter surface or by Phase Contrast Microscopy (PCM) with a limit of0.010 fibers per cubic centimeters of air in accordance with the above Rhode Island regulation sections.

C. The consultant's project monitor shall provide continual evaluation of the air quality of the building during removal, using his/her best professional judgment in respect to the State of Rhode Island Department of Public Health guideline of 0.010 fibers/cc and the background air quality established during the pre-abatement period.

D. If the project monitor determines that the building air quality has become contaminated from the project, he/she shall immediately inform the contractor to cease all removal operations and implement a work stoppage clean up procedure. The contractor shall conduct a thorough cleanup of the areas of the building designated by the consultant. No further removal work can take place until the project monitor has assessed that the building air has been decontaminated.

E. Pre-abatement and abatement air samples shall be collected as required to obtain a volume of 1,200 liters. Samples shall be analyzed by Phase Contrast Microscopy (PCM) methodology using the NIOSH 7400 protocol.

3.4 CONSULTANT'S INSPECTION RESPONSIBILITIES

A. The consultant shall conduct inspection throughout the progress of the abatement project. Inspections shall be conducted in order to document the progress of the abatement work as well as the procedures and practices employed by the abatement contractor.

B. The consultant shall perform the following inspections during the course of abatement activities:

1. Pre-commencement Inspection: Pre-commencement inspections shall be performed at the time requested by the abatement contractor. The consultant shall be informed 12 hours prior to the time the inspection is needed. If, during the course of the pre-commencement inspection, deficiencies are found, the contractor shall perform the necessary adjustments in order to obtain compliance.
2. Work Area Inspections: Work area inspections shall be conducted on a daily basis at the discretion of the consultant. During the course of the work inspections, the consultant shall observe the contractor's removal procedures, verify barrier integrity, monitor negative air filtration devices, assess project progress, and inform the abatement contractor of specific remedial activities if deficiencies are noted.
3. Pre-encapsulation/Final Visual Inspection: The consultant, upon the request of the abatement Contractor, shall conduct a pre-sealant inspection. The consultant shall be informed 24 hours prior the time that the inspection is needed. The pre- encapsulation inspection shall be conducted after completion of the all cleaning procedures, but prior to encapsulation. The pre-encapsulation inspection shall verify that all ACM and residual debris have been removed from the work area. If, during the course of the pre-encapsulation inspection, the consultant identifies residual dust or debris, the contractor shall comply with the request of the consultant in order to render the area "dust free."

3.5 CLEARANCE AIR TESTING

A. After the visual inspection is completed and all surfaces in the abatement area have dried, final air clearance sampling shall be performed by the consultant. Aggressive air monitoring will be used. Selection of location and samples shall be the responsibility of the consultant. Air monitoring volumes shall be sufficient to provide a detection limit of 0.010 f/cc using NIOSH-approved method for PCM analysis. For air clearance by Transmission Electron Microscopy, air-monitoring volumes shall be sufficient to provide a detection limit of 0.005 f/cc using the AHERA Level II Yamate Method. Areas which do not comply with the Standard for Cleaning for Initial Clearance shall continue to be cleaned by and at the contractor's expense until the specified Standard of Cleaning is achieved as evidenced by results of air testing as previously specified.

3.6 ASBESTOS WASTE DISPOSAL

A. The contractor shall package, label, and remove all asbestos waste from the work area in accordance with Rhode Island DOH regulations, all other applicable regulations, and as specified below. Packaging shall be accomplished in a manner that minimizes waste volume but insures waste containers shall not tear or break. All waste shall be transported in leak tight containers.

B. Asbestos wastes may include building materials, insulation, disposable clothing and protective equipment, plastic sheeting and tape, exhaust systems or vacuum filters, contractor equipment, or other materials designated by state or local authorities which have been potentially contaminated with asbestos and have not been fully cleaned.

C. Waste Labeling

1. Warning labels, having waterproof print and permanent adhesive in compliance with OSHA, EPA, RIDOT and RIDOH requirements, shall be affixed to or printed on the sides of all waste bags or transfer containers. Warning labels shall be conspicuous and legible, and contain the following words:

DANGER
CONTAINS ASBESTOS FIBERS
MAY CAUSE CANCER CAUSES
DAMAGE TO LUNGS DO NOT
BREATHE DUST AVOID
CREATING DUST

2. In compliance with NESHAP, 40 CFR, Part 61.150, all waste containers or bags shall be labeled with the following generator information:

   a. Name of waste generator
   b. Location of where waste was generated

D. Wetting of Waste: A fine water spray shall be used to keep the top layers of waste in containers thoroughly wet at all times. When a waste bag is full, air within the bags shall be evacuated with a HEPA equipped vacuum and be securely sealed with tape or other secure fastener.

E. Use and Decontamination of Fiber Drums: The Contractor's use and decontamination of fiber drums shall be in accordance with RIDOH, EPA and DOT requirements. The drums shall be lined with a minimum of two layers of 6-mil asbestos waste bags. The waste will be appropriately labeled and sealed. The drums shall be sealed with an airtight lid and shall be decontaminated and/or additionally bagged if the drums are filled inside the containment and visible debris/contamination is observed on the exterior of the drums. All waste shall be labeled as previously described. The drums and waste will be re- containerized should their integrity be compromised and/or liquid is visibly passing through or staining the container.

F. Waste Container Storage: The container used for the storage of bagged contaminated waste shall be an enclosed dumpster. The dumpster shall have a solid metal roof and a solid metal door with padlock. At a minimum, line the cargo area with two layers of a 6- mil polyethylene sheeting to prevent contamination from damaged or leaking containers. Floor sheeting shall be installed first and shall extend up the sidewalls 24 inches minimum. Wall sheeting shall be overlapped and taped securely into place. No un-bagged contaminated waste or non-asbestos waste shall be stored in these dumpsters. Ensure that bags placed in dumpsters are undamaged. Warning signs shall be posted on the dumpster in accordance with Sections 29 CFR 1926.1101 of the OSHA regulations.

G. Waste Removal Scheduling: All waste containers shall be decontaminated and removed from the Site before final cleanup is started and isolation barriers are taken down.

H. Waste Transportation and Disposal

1. It is the responsibility of the contractor to determine and insure that the contractor and his/her subcontractor are complying with: 1) current waste handling regulations; and 2) the current regulations for transporting and disposing waste at the ultimate disposal landfill. The contractor must comply fully with these regulations, and with all U.S. Department of Transportation, State, local, and EPA requirements.
2. The contractor's waste hauler and disposal contractor shall maintain a valid hazardous waste transporter's permit and identification number; and obtain complete, and fully comply with any other local hazardous waste manifesting requirements.
3. Exercise care before and during transport to ensure that no unauthorized persons have

access to the containerized ACW.

4. Do not transport ACW on open trucks. Treat and dispose of drums that have been contaminated as asbestos-containing waste.
5. A copy of ACW manifest forms shall be sent to the Owner after each disposal is completed and all required data and signatures have been inserted.
6. The contractor shall return the original Disposal Certificate (landfill receipt) to the Owner within 10 working days of waste shipment from the Site.

END OF SECTION 028213

SECTION 02 83 30
MICELLANEOUS HAZARDOUS MATERIALS HANDLING AND REMOVAL

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 – GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Comply with the United States Environmental Protection Agency (USEPA) Renovation, Repair, and Painting (RRP) Rule Title 40 CFR, Part 745 and the Occupational Safety and Health Administration (OHSA) Demolition Involving Lead-Based Paint regulation (Title 29 CFR, Part 1926.62).

B. Comply with USEPA Resource Conservation and Recovery ACT (RCRA) regulations located at Title 40 CFR, Part 263 for disposal of hazardous wastes.

C. Conduct the work as described herein, including but not limited to, the following:

1. Handling, containerizing, packaging, re-handling, documentation, permits, health and safety, transportation and disposal of all items identified.
2. Removal, characterization and disposal of containers, drums, and unknown materials.
3. File necessary notices, obtain all permits and licenses and pay all governmental taxes, fees, and other costs associated with the Work. Obtain necessary approvals of governmental departments having jurisdiction of the Work.

D. Develop and implement a Health and Safety Plan.

E. Demolition, handling, transportation, and disposal of hazardous materials and building materials which are coated with lead-based paint (LBP).

1. Personnel who disturb LBP shall be properly trained and qualified; use appropriate personal protection; use methods that do not create lead dust, chips, or fumes; and properly dispose or recycle components that are coated with LBP.
2. Dispose of LBP wastes in accordance with governing laws and regulations; pay costs of permits and disposal.

F. Identify, sample for disposal, package, label, document, remove, transport and dispose of containerized waste, refrigerants, oils, lubricants, paints, coatings, cleaners, lighting ballasts and fluorescent lamps, mercury switches, transformers, thermostats and any discovered items behind fixed walls or buried vaults.

G. Related Sections:

1. Section 028320 - Asbestos Abatement.

1.3 SUBMITTALS

A. The Contractor shall be made aware that Lead Containing Paint (<0.5%) exists on painted surfaces throughout the building.

B. The Contractor is required to ensure the protection of workers performing asbestos abatement and any related demolition work that will affect surfaces coated with LBP, as well as protecting the public and the environment from exposure to lead-containing dusts.

C. Contractor is responsible to either sample and analyze painted surfaces or assume that all existing painted surfaces are coated with LBP. Contractor is responsible for costs for sampling and analysis, at no additional cost to the Owner.

D. The responsibilities of the Contractor in this Section include the furnishing of labor, materials and equipment required to remove, contain, recover, and dispose lead coatings and associated waste.

1. Removal of paint from surfaces to facilitate demolition;
2. Removal of temporary containment system structures daily, or as allowed by the Architect;
3. Hazardous waste characterization sampling and analysis and disposal of abatement or demolition debris generated as a result of LBP removal and demolition in accordance with requirements of this section and Federal and State regulations pertaining to hazardous and solid wastes.
4. Personal air sampling as required by OSHA for Contractor’s employees that have the potential for exposure to airborne lead dusts as outlined in this section.

E. The Work of this Contract shall conform to the standard set by the applicable federal, state and local laws, regulations, ordinance and guidelines as they exist at the time of the Work and as may be required by subsequent regulations.

F. The Contractor and their subcontractors shall, at their own cost and expense, comply with laws, ordinance, rules and regulations of Federal, State, Regional and Local authorities during demolition, work preparations, sanding, cutting, burning, scraping, painting over, grinding and regarding handling, storing, transporting and disposing LBP and lead-contaminated waste materials.

G. The Contractor shall submit to the Owner’s representative prior to commencing the Work the following:

1. Written respiratory and notification program
2. Written lead compliance program in accordance with OSHA regulations including:
    a. Current training requirements, state certifications.
    b. Supervisor qualifications.
    c. Written compliance program specific to this project
    d. Current (within 12 months) respirator fit test records.
    e. Current medical monitoring and surveillance certificates.
3. Insurance certificates.

H. Work Plan: Site-specific OSHA compliant plan with sequencing with identification of temporary storage areas.

I. Permits for transport and disposal of waste and debris: Submit copies of manifests and receipts within 30 days of completion of the Work.

J. Laboratory analytical results for waste disposal characterization.

K. Personnel protection plan.

1.4 REGULATORY REQUIREMENTS

A. The following references are cited as current applicable publications. The Work is subject to compliance with all regulations including but not limited to:

1. OSHA
    a. General Industry Standards, 29 CFR 1910. .
    b. Lead Standard for General Industry, 29 CFR 1910.1025.
    c. Respiratory Protection, 29 CFR 1910.134.
    d. Hazard Communication, 29 CFR 1910.1200.
    e. Specifications for Accident Prevention (Sign and Tags), 29 CFR 1910.245.
    f. Construction Industry Standards, 29 CFR 1926.
    g. Construction Industry Lead Standard, 29 CFR 1926.62.
2. USEPA, Resource Conservation and Recovery Act (RCRA).
3. United States Environmental Protection Agency Regulations, 40 CFR Part 261.

4. Rhode Island Department of Health.

1.5 OTHER HAZARDOUS MATERIALS

A. The Contractor is hereby informed that equipment, switches or transformers containing PCBs, and mercury-containing lamps, thermostats or switches may exist within the building. Equipment and fixtures containing hazardous materials must remain intact for proper disposal.

B. Responsibility for Hazardous Material Identification: The Contractor shall be responsible for taking necessary measures, methods or procedures appropriate to safeguard the health and safety of workers, visitors, and members of the public with respect to identification and of previously unidentified hazardous materials during the Work.

C. Contractor shall be solely responsible for means and methods, and techniques used in the identification, sampling, collection, segregation, transportation and disposal of Hazardous Materials. Contractor is responsible for all sampling for laboratory sampling and analysis for disposal.

D. Contractor shall at their own cost and expense comply with the Federal, State, and local laws, ordinance, rules and regulations during dismantling, demolition, and cutting of equipment containing hazardous materials, and the handling, storing, transportation and disposal of hazardous materials.

E. Contractor shall be responsible for immediately notifying the Owner of evidence of a release of hazardous materials into the building or to the environment.

PART 2 - EXECUTION

2.01 EXECUTION

A. Prior to the commencement of work that may cause employees to be exposed to an airborne concentration of lead above the Permissible Exposure Limit (PEL), isolate the work area.

B. Provide personnel monitoring, air sampling, recording and reporting in accordance with OSHA standards when work involving a potential exposure to airborne lead is in progress.

C. Dispose of hazardous wastes and materials contaminated by lead-based paint in accordance with applicable regulations and guidelines, including the requirements of RCRA. Lead containing materials must be tested for Toxicity Characteristic Leaching Procedure (TCLP) analysis to determine appropriate disposal requirements.

2.02 SCHEDULE OF REMOVALS

A. Hazardous Material Locations – Any painted surfaces to be affected during building demolition. The Contractor is responsible for verifying final quantities prior to start of work. Contractor is responsible for characterizing via laboratory analysis all materials for disposal at no cost to owner.

2.3 WORK PROCEDURE

A. The work practices listed below are restricted during lead paint abatement activities:

1. Open-flame burning or torching is prohibited.
2. Machine sanding or grinding or abrasive blasting or sandblasting is prohibited unless used with High Efficiency Particulate Air (HEPA) exhaust control which removes particles of 0.3 microns or larger from the air at 99.97 percent or greater efficiency.
3. Dry scraping is permitted only in conjunction with heat guns or around electrical outlets or when treating defective paint spots totaling no more than 2 square feet in any one room, hallway or stairwell or totaling no more than 20 square feet on exterior surfaces.
4. Operating a heat gun is permitted only at temperatures below 1100 degrees Fahrenheit.

2.4 WORK AREA CLEARANCE

A. The work is complete when the work area is visually clean and the Contractor is to notify the Project Monitor that the area is ready for visual inspection. The visual inspection is performed to determine if deteriorated painted surfaces and/or visible amounts of dust or residual paint are still present.

B. The visual inspection and clearance sampling are to be conducted by the Contractor's Certified Inspector.

C. Following the visual inspection, clearance sampling for lead in dust shall be conducted. The clearance sampling shall be in accordance with 40 CFR 745.227(e)(8).

D. Upon completion of the work area clearance the Contractor shall submit to the Owner's representative an abatement report prepared by the Certified Supervisor in accordance with 40 CFR 745.227(e)(10).

END OF SECTION 028330

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SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes
   1. Furnish, install, and remove formwork, shoring and temporary structural supports for cast-in-place concrete.
   2. Installation of inserts, anchors and other embedded items.

B. Related Sections
   3. 032000 – Concrete Reinforcing.
   4. 033000 – Cast-in-Place Concrete.

1.3. REFERENCES

A. American Concrete Institute (ACI).
   1. ACI 117 – “Tolerances for Concrete Construction and Materials”.
   2. ACI 301 – “Specification for Structural Concrete for Buildings”.
   3. ACI 318 – “Building Code Requirements for Structural Concrete”

1.4. SUBMITTALS

A. General: Review of submittals is of a general nature only, and responsibility for conformance with intent of drawings shall remain with the Contractor. Review does not imply or state that fabricator has correctly interpreted the construction documents.

B. Submit Shop Drawings to showing location and layout of construction joints, reveals, form joints, sleeves, openings, textures, locations of tie holes or plugs, and location of embedded items, and other items which will be exposed on the finish wall.

C. When a mock-up is required submit shop drawings of the mock-up.

D. Submit a shoring / reshoring plan that defines when shoring / reshoring will be used and for how long. Show how forces will be transferred to the reshores. Show that procedures will not cause damage to the structure nor result in additional permanent deflections. Provide calculations by a Professional Engineer.

E. Submit manufacturer’s data for formwork release agent. Indicate the form surfaces where the formwork release agent will be used.

1.5. QUALITY ASSURANCE

A. Formwork and Shoring Design:
   1. Form, shoring, and reshoring design shall be the sole responsibility of the Contractor; resultant concrete to conform to required shape, line and dimensions.
   2. A Professional Engineer licensed in the State of Massachusetts shall design forms, falsework supports and reshoring.

B. PRODUCT DELIVERY, STORAGE AND HANDLING

C. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Forming Materials:
   1. Formwork materials shall be appropriate for the specified finishes.
   2. Polystyrene Foam: ASTM C 578 – Type IV
   3. Chamfer Strips: rigid PVC; 3/4-inch by 3/4-inch size; maximum possible length. Material usage shall be consistent for each application
   4. Form Gaskets (for sealing form panel joints) Gaskets shall be closed cell, completely skinned, foam rubber or neoprene, with pressure sensitive paperbacked adhesive on surfaces to be bonded to forms. Gaskets shall be of sufficient thickness, widths and compressibility for specific use.

2.2. FORM HARDWARE

A. All form ties shall be a type which does not leave an open hole through the concrete and which permits neat and solid patching at every hole.

B. When forms are removed, all metal shall be not less than one inch from the surface.

C. Use commercially manufactured formwork accessories. Do not use wire ties and wood spreaders.

D. Where wall is exposed to view in final structure use form ties with cones.

E. Form Ties: Ties shall leave a hole of not more than 3/4" in diameter on the concrete surface, and no metal closer than 1" from the surface. Use stainless steel leave in material.

2.3. FORMWORK RELEASE AGENTS

A. Use commercially manufactured form release agents.

B. Formwork release agents and sealers shall not harmfully affect the appearance, discolor or change texture of finished concrete surface or inhibit proper application of any surface finishes, coatings or bonding agents.

C. Formwork release agents shall prevent the adhesion of forms to concrete.

2.4. EMBEDDED ITEMS

A. Expansion joint filler: Premolded expansion joint filler conforming to ASTM D 994, ASTM D 1751, or ASTM D 1752.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Inspection:
   1. Prior to Work of this Section, carefully inspect the installed Work of other trades and verify that such Work is completed to the point where this installation may properly commence.
   2. Verify that forms are constructed in accordance with all applicable codes and regulations, the referenced standards, and the design documents.

B. Discrepancies:
   1. In the event of discrepancy or conflict, immediately notify the Architect.
   2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2. CONSTRUCTION OF FORMS

A. When a mock-up of the concrete is required do not construct forms for concrete, other than for mock-up, until mock-up has been accepted.

B. Earth Forms: Unless otherwise indicated or required by the Construction documents, concrete for foundations that will remain in permanent contact with the soil, may be placed directly against vertical excavated surfaces provided the material will stand without caving and suitable provisions are taken to prevent raveling of top edges or sloughing of loose material from walls of excavation. Sides of excavation shall be made with a neat cut and the width made as detailed on Drawings.

C. Layout:
   1. Form all required cast-in-place concrete to the shapes, sizes, lines, and dimensions indicated on the Drawings. Camber forms where camber is indicated.
   2. Construct all required forms to be substantial, sufficiently tight to prevent leakage of mortar, and able to limit deflection when filled with wet concrete.
   3. Make proper provision for all openings, offsets, sleeves, recesses, anchorage, blocking, reglets, chases and other features of the Work as shown or required.
   4. Provide openings as required for placing and consolidation of concrete. Provide temporary holes in formwork to facilitate cleaning and inspection.

5. See Drawings for boards, strips, or other methods of creating patterns, textures, and reveals on concrete surfaces.
6. For exposed or smooth surfaces minimize, to a practical minimum, the number of seams.
7. Form Ties for Exposed Surfaces: Locate as shown on drawings. Unless otherwise indicated arrange in a symmetrical regular pattern in level horizontal rows and plumbed vertically. Coordinate variations or changes in pattern from those shown on the drawings, with the Architect.
8. For all spans greater than 30 ft in length, forms shall have a minimum camber at the center of the span of 1/8 in x span length in ft/10 in inches. Camber of joists and girders shall be additive.
9. Conform to the provisions in sections 2.3.1.1 and 2.3.1.3 through 2.3.1.5 of ACI 301.

A. Construction Joints
1. Construction joints in exposed surfaces shall be made only at revealed form joint locations as indicated on the Architectural drawings.
2. Where joints in addition to those shown are desired, Contractor shall propose location of construction joints in submittal. Location of construction joints shall be based on provisions in section 2.2.2.5 of ACI 301
3. Revisions to reinforcing necessary to accommodate contractors proposal will be at Contractors expense.
4. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints sufficient to develop reinforcement.

B. Tolerances
1. Concrete surfaces shall not exceed the tolerances as specified in ACI 117. The class of surface for offset between adjacent pieces of formwork for formed surfaces shall be to Class Cas defined in ACI 117.
2. Maximum deflection of form facing material between studs as well as deflection of studs and walers shall be limited to 1/360 of the span nor more than 1/8-inch.
3. In addition conform to section 2.2.2.4 of ACI 301.

C. Construction:
1. Tape all joints at forms for concrete exposed in the finished structure, including joints between form panels and trim strips.
2. Provide 3/4-inch chamfers in the corners of formwork on permanently exposed surfaces. Do not bevel re-entrant corners or edges of formed joints.
3. Make all form panel joints, tight butt joints with all edges true and square.
4. Do not install inside forms until reinforcing installation has been inspected.
5. For slabs on grade verify top of subgrade is compatible with slab thickness shown.
6. Remove loose concrete, dust, and other material from the existing concrete surface prior to the erection of forms.
7. Reveal Formers and Reformers for Exposed Surfaces: Fabricate and fasten to avoid protruding splinters which may become embedded in the concrete.

D. Finishes:

1. Formed Finishes:
   a. For concrete surfaces exposed to view, unless otherwise noted, forms shall impart a smooth uniform appearance to the concrete without mottles and color variations caused by non-uniform absorption of moisture or chemical reaction.
   b. Concrete surfaces not exposed to view shall have a smooth uniform appearance.
2. Textures: Except as noted under Concrete Finishes, the forms will be smooth and impart no texture to surface of concrete.
3. Provide formwork for Architectural Grade concrete with the intent to provide a smooth, glossy finish, upon removal of the form, with no patching, stoning or other form of repair. Wash only.
4. Vertical form joints are to be plumb and horizontal joints level.
5. Fasten all contact material to supports with fasteners arranged in a symmetrical pattern. Fasteners shall be aligned horizontally and vertically.

E. Form Release Agents:
1. Apply form release agent on formwork in accordance with manufacturer's recommendations.
2. Apply form release agents prior to placing reinforcing steel and embedded items.
3. Keep form release agents away from reinforcing steel, embedded items, and concrete against which fresh concrete will be placed.

3.3. EMBEDDED ITEMS

A. Prior to concrete placement install and build into the work anchorage devices, inserts, and other items embedded in cast-in-place concrete. Use setting drawings, diagrams, instructions and directions for items to be attached thereto.

B. Install concrete accessories and embedded items in accordance with manufacturer's recommendations: straight, level, and plumb. Tolerances of embedded items shall be compatible with the systems they are a part of when more restrictive than specified for concrete work.

C. Provide pipe sleeves when pipes pass through concrete.

D. Fill voids in sleeves, inserts, and anchor slots with readily removable material to prevent entry of concrete into voids.

E. Notify the Architect whenever any embedded item interferes with the placing of the reinforcing steel or placement of concrete.

F. Comply with ACI 301, sections 2.3.1.10 and 2.3.1.11.

G. Use templates to securely hold anchor bolts other embedded items in place during construction, and take care that no displacement occurs during the pouring of concrete.

H. Conduits and Pipes in Concrete:
1. Do not run conduits, wires and pipes in concrete unless specifically indicated on the Drawings.

I. Waterstops: Comply with ACI 301, section 2.2.3.5. Wire tie waterstops at top to prevent displacement.

3.4. PREPARATION FOR PLACEMENT

A. Clean and prepare existing concrete surfaces prior to installing forms.

B. Clean and inspect forms, embedded materials, and existing concrete surfaces immediately before placing concrete.

C. The formwork for second placement of construction joints shall be gasketed and held tight to the in place concrete to prevent fluid loss.

1. Comply with ACI 318 section 6.3 for conduits and pipes embedded in concrete.
2. Maintain specified concrete cover for all conduits in concrete.
3. Reinforcing should not be displaced form required position due to conduits and pipes.

3.5. SHORES AND BRACES

A. Provide support for concrete until the structural system is substantially completed and has obtained its specified strength. If a lower compressive strength is proposed for removal of formwork and shoring, submit detailed plans for review and acceptance. As a minimum forms, shoring, and reshoring shall comply with the provisions of sections 6.1 and 6.2 of ACI 318.

B. Protect the concrete from cracking due to early application of loads or from loads in excess of those shown on the drawings.

C. Shores shall transfer loads from successive parts of the structure directly through falsework without creating bending, tensile, or shearing stresses in the concrete.

D. Reshoring shall comply with section 2.3.3 of ACI 301.

3.6. REMOVAL OF FORMS

A. Time of form removal shall depend on the strength of the concrete and the curing. When concrete mix contains fly ash, has been exposed to cold weather, curing has not been effective, or concrete strengths are lower than expected, defer form removal.

B. Forms and shoring used to support the weight of concrete shall remain in place until the concrete has reached its specified strength. Forms may be removed at an earlier time if acceptable justification is provided.

C. Forms shall be removed without damage to the concrete.

D. Formwork removal shall comply with section 2.3.2 of ACI 301

E. All forms below ground surface along with all shores and braces, shall be removed before backfilling.

F. Bolts, wires, clamps, rods, etc., not necessary to the Work, shall be removed to a minimum of one inch from the surface. Use care to eliminate any danger of rust stains from unprotected materials embedded in or adjacent to exposed concrete surface.

G. Whenever the formwork is removed during the curing period, the exposed concrete shall be cured by one of the methods specified in Section 033000.

H. Removal of forms shall comply with weather protection requirements in Section 03 30 00.

3.7. RE-USE OF FORMS

A. Re-use of forms shall in no way delay or change the schedule for placement of concrete from the schedule obtained if all of the forms were new, nor shall quality, appearance, or performance of the final structure be reduced.

END OF SECTION 031000

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SECTION 032000 – CONCRETE REINFORCING

PART 1 - GENERAL

1.1. DESCRIPTION

A. Work Included - Furnish and place all reinforcing steel and accessories.

B. Related Work Specified Elsewhere:
   1. 031000 – Concrete Forming and Accessories.
   2. 033000 – Cast-in-Place Concrete.

1.2. REFERENCES

A. American Concrete Institute (ACI).
   1. ACI 301 - "Specification for Structural Concrete for Buildings."
   2. ACI 318 - "Building Code Requirements for Reinforced Concrete".

B. American Society for Testing and Materials (ASTM).
   1. A 82 - "Standard Specification for Cold-Drawn Steel Wire for Concrete Reinforcement".
   2. A 615 - "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement".
   3. A 616 - "Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement".
   4. A 617 - "Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement".
   5. A 706 - "Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement".
   6. A 1064 – “Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete”.

C. American Welding Society (AWS).
   1. AWS D1.4 - "Structural Welding Code - Reinforcing Steel".

1.3. SUBMITTALS

A. General: Review of submittals is for general conformance with the design concept of the project and information shown on the contract documents only. The Contractor is responsible for conforming, correlating and coordinating dimensions in the field for tolerance, clearances, quantities, fabrication and installation processes means and methods of construction, coordination of this work with other trades and performing work in a safe and satisfactory manner.

B. Shop Drawings:

1. Submit fully detailed shop drawings for review. Shop drawings shall include:
   a. Placing drawings, bending schedules and bending diagrams showing size and location of reinforcing steel.
   b. Elevations of beams and walls.
   c. Details of areas of congestion. Identify where reinforcing steel will interfere with the placement of embedded items such as anchor bolts, anchors, inserts, conduits, sleeves and any other items which are required to be cast in concrete.
2. Reinforcing steel shall not be fabricated or placed before the shop drawings have been reviewed by the Architect and returned.
3. Direct copies of the contract documents are not acceptable as a submission from the Contractor.

C. Mill Certificates: Submit steel producer's certificates of mill analysis, including steel source, description, heat number, yield point, ultimate tensile strength, elongation percent, bend test and the chemical composition of each heat as determined by ladle analysis, before delivery of steel to site. Where steel is required to be welded, mill reports shall be used to help verify the weldability of the steel.

D. Manufacturers Certification: Furnish electrode manufacturer’s certification that the electrode meets the requirements of its AWS classification.

E. Welding Procedures: Submit welding procedures for all reinforcement welding.

1.4. QUALITY ASSURANCE

A. Owner's Testing Laboratory

Shop and field testing and inspection of steelwork will be performed by an independent laboratory engaged by the Owner ("Inspector"). The inspector shall be currently certified as a AWS Certified Welding Inspector.

B. Qualifications of Welders:
1. All welding shall be performed by operators who are qualified for the types of welds used. Each operator shall have been qualified within the preceding one year as prescribed by AWS. Welder qualification shall include passing the Charpy tests when specified for the electrode.
2. Require welders to retake the qualification test if, as determined by the Architect, there is a reasonable doubt as to the proficiency of the welder. If the welder does not requalify, he shall not perform any welding on the project.
3. Pay all costs associated with welder qualification.

1.5. PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver reinforcement to jobsite bundled, tagged and marked. Use tags that indicate bar size, lengths and marks corresponding to markings shown on shop drawings.

B. Storage: Store reinforcement at the jobsite in a manner to prevent damage and accumulation of dirt and rust, moisture and grease or any other substance that may impair bond to concrete. Do not use damaged, reworked or deteriorated material.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Reinforcing Bars ASTM A615, Grade 60 or ASTM A706.

B. Reinforcing Bars to be Welded: ASTM A706.

C. Plain Wire: ASTM A82.

D. Deformed Wire: ASTM A496.

E. Welded Wire Fabric: ASTM A185 for plain wire fabric or ASTM A 497 for deformed wire fabric.

F. Tie Wire: American Wire 16 gauge or heavier black annealed wire.

G. Spiral Reinforcement: ASTM A82 if specified as wire or ASTM A615-Grade 60 if specified by bar size.

H. Accessories:

1. Metal or plastic spacers, supports, ties, precast concrete blocks, etc., as required for spacing, assembling, and supporting reinforcing in place.
2. Legs of accessories to be of type that will rest on forms without embedding into forms.
3. Galvanize metal items where exposed to moisture, or use other acceptable non-corrodible, non-staining supports.
4. Do not use wood, brick, or stone supports.
5. Where supports bear on earth, use concrete blocks or supports with sand plates.
6. On surfaces of walls to be sandblasted or where exposed to view in the final structure supporting chairs, spacers, or bolsters, shall be of stainless steel.

I. Electrodes for Welding Reinforcing Steel: As required by AWS D1.4.

J. Reinforcing Couplers: Lenton rebar couplers as manufactured by Erico or equal. Connection shall develop in tension or compression as required at least 125 percent of specified yield strength of the bar.

K. Mechanical Splices:

1. Cadweld full tensile strength splices as manufactured by Erico. Splices to be capable of developing 125 percent of reinforcement yield strength.
2. Lenton full tensile strength coupler as manufactured by Erico or approved alternate. Splices to be capable of developing 125 percent of reinforcement yield strength.
3. Notify mechanical splice supplier of rolling mill that rolled reinforcement to be spliced.

L. Deformed Bar Anchors: Nelson, flux filled deformed bar anchors, type D2L, as manufactured by Nelson Stud Welding Division of TRW or approved alternate.

2.2. FABRICATION

A. General: Fabricate reinforcing bars in accordance with the tolerances of ACI 117.

B. Bending:
   1. Minimum bend diameters and hook extensions as shown on the drawings.
   2. Reinforcing bars are to be bent cold unless heating is permitted.
   3. Do not bend or kink reinforcing except as shown on the Drawings.
   4. Do not bend or straighten reinforcing bars in a manner that will injure the material.
   5. Do not rebend reinforcement that has previously been bent within 6 inches of new bend except as allowed in section 3.3.2.8 of ACI 301.

C. Spirals: Provide a minimum of 1-1/2 finishing turns top and bottom.

D. Install reinforcing couplers and mechanical splices in accordance with the manufacturer's recommendations.

E. Install deformed bar anchors in accordance with the manufacturer's recommendations.

2.3. MATERIAL TESTING

A. No testing will be required for domestically, manufactured reinforcing steel if the mill reports show the material conforms to these specifications. Testing by the Owners Testing Laboratory will be required for all reinforcing steel of foreign manufacture, and for all reinforcing steel of domestic manufacture that cannot be identified with mill reports.

B. Testing
   1. Identify reinforcing steel and make one series of tests (tensile, bend and chemical) from each five tons, or fraction thereof, of each size and kind of foreign or unidentified reinforcing steel to demonstrate its compliance with the specified reinforcing. If reinforcing steel is from foreign sources, testing is required from each five tons, or fraction thereof, from each source.
   2. Use full section of the reinforcing steel "as-rolled" for test specimens Sections machined or reduced in accordance with ASTM A 615, Section 9, "Test Specimens" will not be acceptable.
   3. Include two samples of sufficient length to allow tests to be made on the ""as-rolled" reinforcing steel.
   4. Perform other tests (such as dimensions and weight) as necessary to establish compliance with specifications.

PART 3 - EXECUTION

3.1. PREPARATION

A. Prior to Work specified in this Section, carefully inspect the installed Work of other trades and verify that such Work is complete to the point where this installation may properly commence.

B. The Contractor shall verify all dimensions prior to starting construction.

C. Discrepancies:

1. Notify the Architect of any discrepancies or inconsistencies.
2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

3.2. INSTALLATION

A. General: Wherever embedded items interfere with placing of reinforcement notify the Architect and obtain approval before placing any concrete. Do not bend or field cut bars around openings or sleeves.

B. Placing:
1. Do not exceed the tolerances specified in ACI 117.
2. Do not place reinforcement in floor slabs or beams until concrete has been placed in columns and walls, except where bars extend down into columns or walls.
3. Dowels shall be tied securely in place before concrete is deposited. In the event there are no bars in position to which dowel may be tied, No 3 bars (minimum) shall be added to provide proper support and anchorage.
4. Use templates for placement of column dowels.
5. Install welded wire fabric in as long lengths as practicable.

C. Field bending or straightening in accordance with section 3.3.2.8 of ACI 301.

D. Welding:
1. Not permitted unless specifically shown on Structural Drawings.
2. Welding, where required, shall comply with AWS D 1.4 and shall be continually inspected during welding.
3. Welding material, wire cuttings, and tramp metal shall be thoroughly cleaned from forms for exposed concrete before any concrete is placed.
4. No tack welds not incorporated into other welds will be allowed without written acceptance.
5. Do not weld within 2 bar diameters of where bars have been bent cold.

E. Spacing of Reinforcing: Where Drawings do not show the spacing of the reinforcing, the minimum clear spacing shall conform to ACI-318 Section 7.6.

F. Concrete Cover: Place reinforcement to obtain as a minimum the coverages for concrete protection specified in section 3.3.2.3 of ACI 301.

G. Splicing: Make splices only at those locations shown on the Drawings or as accepted by the Architect. Stagger splices in adjacent bars wherever possible.

H. Reinforcing Supports:
1. Reinforcement shall be accurately located in the forms and held in place by means of supports adequate to prevent displacement and to maintain reinforcement at proper distance from form face. The use of wood supports and spacers inside the forms is not permitted.

2. Support reinforcement supported from the ground on precast concrete reinforcement supports.
3. Do not use reinforcing supports or reinforcing to support concrete conveying equipment and similar construction loads.

I. Tying:
1. Reinforcing shall be rigidly and securely tied with steel tie wire. Tie wires, after cutting, shall be bent in such a manner that concrete placement will not force the wire ends to surface of exposed concrete.
2. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
3. Reinforcing in concrete members that have one or more surfaces exposed, whether painted or unpainted finish, shall be tied with galvanized wire. Uncoated tie wire in exposed members will not be accepted.

J. Install deformed bar anchors in accordance with the manufacturer's recommendations.

K. Install mechanical splices and reinforcing couplers in accordance with manufacturers' recommendations.

L. Installation of manufactured products as per Part 2 of this specification and according to manufacturers' recommendation.

M. Cleaning:
1. Clean reinforcement to remove loose rust and mill scale, earth and other materials which might reduce or destroy bond with concrete.
2. Where there is a potential of rust staining adjacent finish surfaces, take necessary steps to prevent staining.

3.3. FIELD QUALITY CONTROL

A. Before any concrete is poured on any particular portion of the building, the reinforcing steel and form dimensions will be inspected by the Owners testing laboratory. Any errors or discrepancies shall be corrected before concrete is placed.

B. Notify both the testing laboratory and the Architect at least 48 hours before concrete is to be poured or reinforcing is covered up.

C. As a minimum, all testing and inspection as per the requirements of the International Building Code 2018 edition. Reinforcing steel to be assumed to have been designed for calculated stresses in excess of 70 percent of the basic allowable values.

D. Installation of deformed bar anchors to be tested in accordance with Section 7.1 of AWS D1.1.

E. Welding of Reinforcement:
1. There shall be continuous inspection during all welding of reinforcement.
2. All butt welds to be inspected using radiographic testing.
3. At the Owners option recognized non-destructive tests such as resistance, Magnetic Partical Examination, and Liquid Penetrant Inspection may be used to inspect the welds.

F. Testing and inspection of mechanical splices and reinforcing couplers to conform to manufacturer's recommendations and ICC approval.

END OF SECTION 032000

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SECTION 033000 – CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1. DESCRIPTION

A. Work Included: The work in this Section includes the cast-in-place concrete work as shown on the drawings and specified herein, including, but not limited to, the following
   1. Substructure and footings.
   2. Concrete slab on grade.
   3. Retaining walls.
   4. Superstructure of the building.

B. Related Work Described Elsewhere:
   1. Section 031000 – Concrete Forming and Accessories.
   2. Section 032000 – Concrete Reinforcing.
   3. Section 033500 – Concrete Finishing.

1.2. REFERENCES

A. American Concrete Institute (ACI).
   1. ACI 301-10 - “Specification for Structural Concrete for Buildings.”
   2. ACI 318-14 - “Building Code Requirements for Reinforced Concrete.”

B. American Society for Testing and Materials (ASTM).
   1. C 31 - “Standard Method of Making and Curing Concrete Test Specimens in the Field.”
   2. C 33 - “Standard Specification for Concrete Aggregates.”
   3. C 39 - “Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.”
   4. C 94 - “Standard Specification for Ready-Mixed Concrete.”
   5. C 143 - “Standard Method of Test for Slump of Portland Cement Concrete.”
   6. C 150 - “Standard Specification for Portland Cement.”
   7. C 157 - “Standard Method of Test for Length Change of Hardened Cement Mortar and Concrete.”
   8. C 192 - “Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory.”
   9. C 233 - “Testing Air-Entraining Admixtures for Concrete.”
   10. C 260 - “Standard Specification for Air-Entraining Admixtures for Concrete.”
   11. C 309 - “Standard Specification for Liquid Membrane - Forming Compounds for Curing Concrete.”
   12. C 330 - “Standard Specification for Lightweight Concrete Aggregate for Structural Concrete.”
   13. C 494 - “Standard Specifications for Chemical Admixtures of Concrete.”

14. C 618 - “Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.”
15. D 1751 - “Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).”
16. E 329 - “Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction.”

C. American Association of State Highway and Transportation Officials (AASHTO).
1. AASHTO TP23 – “Standard Test Method For Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.”
2. AASHTO T260 – “Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials.”

1.3. DEFINITIONS

A. Architectural Concrete: All concrete exposed to view in the completed structure including but not limited to walls, columns, curbs, beams, parapets, slabs, or stairs, and as indicated on the Drawings.

1.4. QUALITY ASSURANCE

A. Qualification of Workmen:
1. Provide one or more persons who shall be present at all times during the execution of this portion of the Work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all Work performed under this Section.
2. The individual directing this work shall have at least 5 years of foreman experience with ‘As-cast’ Architectural concrete.
3. For finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced journeymen concrete finishers.

B. Owner’s Testing Laboratory:
1. Plant and field inspection and testing of concrete will be performed by an independent testing laboratory employed by the Owner.
2. The Owners use of a Testing Laboratory shall in no way relieve the Contractor of the responsibility to furnish materials and construction in full compliance with the Drawings.
3. If Contractor wants the Testing Laboratory to perform additional compression tests in order to establish compliance with specification requirements at an earlier date, he shall notify the Owners testing laboratory and reimburse the Owner for the expense.

C. Construction Conference:
1. Within 30 days prior to the start of concrete work, the Contractor shall schedule a meeting at a mutually agreeable time to include the Architect, appropriate Architects Consultants, [General Contractor][the Construction Manager], and appropriate subcontractors, the Concrete Supplier to discuss materials, methods of work, forming system and mixes for all classes of concrete.
2. The contractor shall send a pre-concrete conference agenda to all attendees 20 days prior to the scheduled date of the conference.

D. Records:

1. Keep a record and make available for inspection at the site, showing time and place of each pour of concrete, together with transit batch tickets per ASTM C94. Batch tickets shall include the time water was added to dry mix in addition to the other information required.
2. Make the records available to the Architect for his review upon request.

1.5. SUBMITTALS

A. General
1. Review of submittals is for general conformance with the design concept of the project and information shown on the contract documents only. The Contractor is responsible for conforming, correlating and coordinating dimensions in the field for tolerance, clearances, quantities, fabrication and installation processes means and methods of construction, coordination of this work with other trades and performing work in a safe and satisfactory manner.
2. Prior to final approval of Shop Drawings for exposed architectural concrete surfaces the Mock-up specified herein shall be completed and approved. Any modifications of the Mock-up formwork shall be incorporated into the Shop Drawings and other submittals.

B. Shop Drawings
1. Submit detailed drawings showing locations of all concrete joints (construction, contraction, and expansion), curbs, depressions, sleeves and openings.
2. Submit plans and other details showing sequence of concrete pours. This will be reviewed only for impact on the performance of the completed structure.
3. Submit details drawings indicating position of waterstops and details to be used for all water tight construction.
4. Submit shop drawings showing formwork features that impact the concrete finishes and textures including but not limited to form joints.
5. Submit shop drawings detailing Mock-up if a mock up has been specified.

C. Submit proposed methods for Cold and/or hot weather concreting when contemplated.

D. Concrete Mix Design:- Submit proposed mix designs for each class of concrete on the Mix Design Submittal form included at the end of this specification. Include the following:
1. Copies of mix designs. Mix designs shall be prepared by an independent testing laboratory.
2. The mix design submittal shall list:
    a. All materials and admixtures and their proportions.
    b. Water and cement content, water cemetitious material ratio, slump, and combined aggregate gradation (percent retained on every sieve size).
    c. Compressive strength documentation of how the strength was determined.
    d. Information on concrete materials as per paragraph 4.1.2.3 of ACI 301.
    e. Whether mix is appropriate for pumping.
    f. Indicate where each mix will be used.
3. This submittal shall include the results of all testing performed to qualify the materials and to establish the mix designs. Include all calculations and tests required by ACI 318 Section 26.4.
4. Test results of total chloride in content.

5. Where shrinkage limit is specified submit shrinkage test results.
6. For lightweight aggregate used submit test results per ASTM C330.
7. For normal weight aggregate submit test results per ASTM C33.

E. Product Data: Submit product data for following products showing compliance with project specifications, manufacturer's recommendations, as well as known limitations. Provide certification that the following materials conform to the standards referenced in this section.
1. Curing materials.
2. Slab treatments.
3. Non-shrink grout.
4. (Shake on) hardeners.

F. Certifications: Submit certification by the manufacturers that each admixturer conforms to requirements specified in this section and that the admixtures are compatible with one another.

G. Submit cement mill tests.

H. Upon completion of the concrete Work, deliver the records of concrete placement and the concrete batch tickets to the Architect.

1.6. MOCK-UP AND SAMPLES OF WORKMANSHIP

A. Provide a mockup of the portion of the structure denoted on the Drawings.

B. Mock-up when accepted will serve as the minimum standard by which workmanship will be measured.

C. The mock-up shall be constructed using the same mixes, materials, products, procedures, and methods as will be used for the perminant construction.

D. Shop Drawing and submittal requirements for the mock-up shall be the same as for the permanent construction.

E. Testing and inspection for the mock-up will be the same as for the permanent construction.

1.7. STORAGE OF MATERIALS

A. Comply with ACI 301 Paragraph 4.1.4.

PART 2 – PRODUCTS

2.1. MATERIALS

A. General:
1. Materials used shall be the same as those submitted and from the same source.
2. When it is proposed to change materials from those submitted, conform to paragraph 4.2.1.5 of ACI 301.
3. It is the responsibility of the contractor to ensure that all products used are comptaible with each other.

B. Cement:
   1. Portland Cement Type I or II, ASTM C 150.
   2. The temperature of cement delivered to the plant shall not exceed 150 degrees F.
   3. Architectural Concrete blended with white cement as required to match color of mock-up / samples.
   4. One brand from the same source shall be used throughout the project.
   5. There shall be no detrimental reaction between the cement and the aggregates used.

C. Normal Weight Aggregates:
   1. ASTM C 33. Aggregates shall be evaluated for reactivity per Appendix XI.
   2. Aggregates shall be from a source of supply which have shown by actual service to produce concrete of the required quality.

D. Lightweight Aggregates: ASTM C 330,

E. Water: clean, potable, and free of deleterious matter. In addition conform to ASTM C94 including the optional chemical tests.

F. Admixtures:
   1. Except where specified herein do not use admixtures without the written acceptance of the Architect. Where more than one is used, admixtures shall be compatible.
   2. Admixtures containing Calcium Chloride Thiocyanates or more than 0.05 percent chloride ions are not permitted.
   3. Do not use admixtures that will negatively impact the visual finish of concrete exposed to view. For concrete exposed to view the finish shall not varry as a result of changes in the use of admixtures.
   4. Water Reducing Admixtures: ASTM C 494, Type A.
   5. Water Reducing, Retarding Admixtures: ASTM C494, Type D.
   6. Non Chloride, Non-corrosive Accelerating Admixtures: ASTM C494, Type C or E. The admixture manufacturer must have long term non-corrosive test data (of at least a year's duration) from an independent testing laboratory using an acceptable accelerated corrosion test method such as that using electrical pltential measures.
   7. Air Entraining Admixtures: ASTM C 260.
   8. High Range Water Reducing Admixtures (Superplasticizers): ASTM C 494, Type F or G.
   9. Fly ash or possolan admixtures:- ASTM C 618, Type C or Type F.

G. Non-Slip Aggregate Finish: Provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packed rust-proof, and non-glazing, and is unaffected by moisture and cleaning materials.

H. Liquid Densifier/Sealer: "Euco Diamond Hard" by The Euclid Chemical Co or approved equal.

I. Penetrating Anti-Spalling Sealer:
   1. ASTM C957-15.
   2. Sealer shall be siloxane-based compound which has a 92% chloride ion screen and a repellency factor of 92% when tested in accordance with NCHRP #244, Test Method.
   3. Sealer treated concrete shall exhibit no scaling when exposed to 125 cycles of freezing-and-thawing.
   4. Tests to establish compliance shall be by an independent testing laboratory.

J. Non-Oxidizing Metalic Floor Hardener: “Diamond-Plate” by the Euclid Chemical Co or approved equal.

K. Metallic Floor Hardener: “Euco-Plate HD” by the Euclid Chemical Co. or “MasterTop 200” by BASF Master Builders or approved equal.

L. Mineral Aggregate Hardener: “Surflex” by the Euclid Chemical Co. or “MasterTop 100” by BASF Master Builders or approved equal.

M. Synthetic Fibers:

1. “Fiberstrand” by The Euclid Chemical Co.”
2. “Forta” by Forta Corp.
3. “Fibermesh” by Propex Fibermesh.

N. Curing Materials:

1. Fiber reinforced asphaltic vapor barrier building paper.
2. Polyethylene sheet 4-mil thickness.
3. Curing compound ASTM C 309, Type 1, clear or transparent and shall not discolor finished concrete surface or inhibit proper application or performance of any surface finishes or treatments. In addition curing compound shall limit maximum moisture loss to 0.03 g/cm^2 at the coverage used on this project.

O. Concrete Sealer: “Super Aqua-Cure VOX” or “Super Diamond Clear VOX” as manufactured by the Euclid Chemical Company.

P. Premolded Joint filler: ASTM D 1751.

Q. Vapor Barrier: Polyethylene sheeting 10 mils thick of approved manufacturer.

R. Water stops: Bentonite waterstops

2.2. CONCRETE MIXES

A. General

1. Contractor shall be responsible for the design of the concrete mixes.
2. Assume full responsibility for the strength, consistency, water cemetitious material ratio and handling of concrete.
3. Admixtures and products shall be used in accordance with the manufacturer’s recommendations.
4. No change of brand or source of any of the concrete ingredients or of the mix proportions will be allowed until submittals have been resubmitted and approved.

B. Proportions:

1. Proportion concrete for strength and workability in accordance with Section 4.2.3 of ACI 301 and the contract documents.
2. Contractor to verify that aggregate size specified for each location is consistent with the forms and dimensions of the section being placed, along with the location and spacing of the reinforcing steel.
3. If the trial batch method is used, use an approved independent testing facility for preparing and reporting the proposed mix designs. Bear all costs in connection with these tests and for the design of the concrete mixes.

4. Adjust the required average compression strength based on subsequent test results for the mix design.
5. Combined aggregate gradation shall result in 8% - 18% being retained on every sieve size except for the top size and No. 100.
6. Limit chloride ion concentrates so as not to exceed the limit set in paragraph 4.3.1 of ACI 318 for ”Reinforced concrete that will be dry in service”.

C. Fly Ash shall be limited as per section 4.2.2.8.b of ACI 301. Concrete to be assumed to be exposed to deicing chemicals.

D. When lightweight aggregates are used the coarse aggregate shall not exceed 9 cubic feet per cubic yard of concrete.

E. Concrete used over metal deck shall be compatible with the recommendations of the ICBO approval for the metal decking.

F. Admixture usage:

1. All concrete slabs, less than 8 inches in thickness, placed at air temperatures less than 50° F, shall contain non-corrosive, non-chloride accelerator.

G. Mixes:

1. Class “A”: For use in foundation, normal weight aggregate, f’c=4000 psi, 1-1/2 inch aggregate, 4 inch maximum slump with water reducing admixture or 8 inch maximum slump with High Range Water Reducing Admixture. Water/cement ratio 0.55 maximum.
2. Class “B”: Typical concrete, normal weight aggregate, f’c=4000 psi, 1 inch aggregate, 4 inch maximum slump with water reducing admixture or 8 inch maximum slump with High Range Water Reducing Admixture, water/cement ratio 0.55 maximum, drying shrinkage limit of 0.045 percent.
3. Class “C”: Exterior concrete exposed to freezing and thawing, normal weight aggregate, f’c=4000 psi, 1 inch aggregate, 4 inch maximum slump with water reducing admixture or 8 inch maximum slump with High Range Water Reducing Admixture, water/cement ratio 0.50 maximum, Air content of 4.5% to 7.5%, [drying shrinkage limit of 0.045 percent].
4. Class “D”: For use over metal decking, lightweight coarse aggregate (115 pcf maximum air dry), f’c=4000 psi, 1/2 inch aggregate, 4 inch maximum slump with water reducing admixture or 8 inch maximum slump with High Range Water Reducing Admixture, water/cement ratio 0.50 percent. Lightweight concrete should have a minimum average 28-day splitting tensile strength of [300 psi] as per Table 2 of ASTM C330.
5. Class “E”: For use as fill when footing was over-excavated, normal weight aggregate 1-1/2 inch aggregate, f’c=500 psi, 4 inch maximum slump with water reducing admixture or 8 inch maximum slump with High Range Water Reducing Admixture.
6. Class “F”: For filling metal stair pans, normal weight aggregate, f’c=2,500 psi, 1/2 inch aggregate, 4 inch maximum slump, water/cement ratio 0.50.
7. Class “G”: For exposed polished concrete topping slab, normal weight aggregate, f’c=5,000 psi , ¾ inch aggregate, 4” maximum slump with water reducing admixture, water/cement ratio .45 maximum, no added air entrainment, maximum admixture 2% of total mix weight, plasticizers, slag, fly ash or other products replacing Portland cement to be a maximum of 10% of Portland cement volume.

H. Clarification of Mix Properties:

1. f’c is the minimum compressive strength at 28 days, tested in accordance with ASTM C39.

2. Slump specified is maximum not to exceed tested in accordance with ASTM C143. If superplasticizers are used higher slumps will be allowed providing this will not lead to segregation of the aggregate and providing that the mix without the superplasticizer meets the slump requirements.
3. Aggregate size is the largest of the coarse aggregate.
4. Air content is by volume.
5. Water/cement ratio is specified by weight.
6. Concrete weight is maximum air dry weight. Unless noted otherwise weight shall be 150 pcf.
7. Drying shrinkage limit is percentage change in length when tested as per ASTM C157 with 4 inches x 4 inches x 11 inches specimen. The specimens shall be stored using the air store option. Measurements shall be taken at the times required by the standard with the measurement taken after eight weeks of air storage to be used to determine compliance with the specified limits.

2.3. MORTARS AND GROUTS

A. Bonding Grout: Approximately 1 part Portland cement to 1 part fine sand passing a No 30 sieve, mixed to a creamy consistency.

B. Patching Mortar for exposed concrete shall be made of the same material and of approximately the same proportions as used for concrete, except that coarse aggregate shall be omitted and mortar shall consist of not more than 1 part Portland cement to 2-1/2 parts damp loose sand by volume.
1. Combine white and gray Portland cement as necessary to match color specified by Architect. Use no more mixing water than necessary for handling and placing.
2. Mix patching mortar in advance and allow to stand with frequent mixing with trowel without adding water until it has reached the stiffest consistency that will permit placing.

C. Drypack for Base Plates: Refer to section 051200 Structural Steel Framing.

D. Non-Shrink Grout for Base Plates: Refer to section 05 12 00 Structural Steel Framing.

E. High Flow Grout:
1. Where high fluidity and/or increased placing time is required, use high flow grout.
2. ASTM C1107, “Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)”.
3. When placed at a fluid consistency there shall be at least 95% bearing under an 18”x36” base plate.

F. Epoxy grout for anchoring fasteners or reinforcing in concrete shall be HIT-HY 200-R as manufactured by Hilti, or SET-3G as manufactured by Simpson Strong-Tie, or AC200+ by Dewalt.

2.4. BONDING AND REPAIR MATERIAL

A. Polymer Patching Mortar: These patching mortars may be used when color match of the adjacent concrete is not required. Prior approval by the Engineer is required.

1. "Thin-Top Supreme" or "Concrete-Top Supreme" by Euclid Chemical Company (horizontal repairs); "Verticoat or Verticoat Supreme" (vertical and overhead repairs) by Euclid Chemical Company.
2. "Sikatop 121 Plus or 122 Plus" (horizontal repairs), "Sikatop 123 Plus" (vertical and overhead repairs) by Sika Chemical Corp.

B. Low Shrinkage Structural Repair Mortar: All horizontal, vertical and overhead areas, so indicated on the plans, or otherwise designated by the Engineer to be repaired, shall use the specified low shrinkage structural repair mortar. This one component polymer, microsilica modified, high strength concrete repair mortar. Product shall be "EucoRepair V100" by the Euclid Chemical Co.

C. Epoxy Adhesive:
1. The compound shall be a two (2) component, 100% solids, 100% reactive compound suitable for use on dry or damp surfaces.
2. Designated repairs shall be made, with prior approval of the Engineer, as to method and procedure, using these epoxy adhesives and/or epoxy mortar. Where epoxy injection procedures must be used, an approved low viscosity epoxy made by these manufacturers shall be used.

"Euco #452 MV or Euco #620 Epoxy System" by the Euclid Chemical Co.

"Sikadur Hi-Mod" by the Sika Chemical Corp

D. Underlayment Compound: Free-flowing, self-leveling, pumpable cementitious base compound.
1. "Flo-Top" by the Euclid Chemical Co.

E. Repair Topping: Self-leveling, polymer modified high strength topping. Product shall be "Thin-Top Supreme" by the Euclid Chemical Co. The topping shall exhibit the following properties:

Chaplin Abrasion Test - 0.02 mm (0.0079") maximum @ 28 days

(British Standard 8204)

2.5. QUALITY ASSURANCE

A. Testing Laboratory will review concrete mix designs.

PART 3 – EXECUTION

3.1. SURFACE CONDITIONS

A. Examination: Prior to Work of this Section, carefully inspect the installed Work of other trades and verify that such Work is complete to the point where this installation may properly commence.

B. Discrepancies:
1. In the event of discrepancy, immediately notify the Architect.
2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

3.2. GENERAL

A. Particular care shall be used when starting a concrete pour to maintain the continuity of appearance. Use all means necessary to avoid blemishes, imperfections, or changes in the finish. Cured colored concrete shall be consistent in color and appearance.

B. Note that the appearance of exposed concrete surfaces depends upon uniform color and texture within any one area and between adjacent areas and exercise strict batching, mixing, placing, curing, etc. controls to achieve this end.

C. Cutting and/or patching made necessary by failure or delay in complying with these requirements shall be at no additional expense to the Owner. No cutting or patching of exposed concrete shall be done without Architects approval.

D. All concrete work shall comply with the tolerances specified in ACI 117.

3.3. PREPARATION

A. Clear away debris and excess water from areas where concrete will be placed. Remove any material from in-place concrete or steel which will impair bond.

B. For concrete placed on soil, the subgrade shall be thoroughly wetted prior to placing.

C. Sandblast all construction joints and under baseplates to clean and roughen the entire surface of the joint, exposing coarse aggregate solidly embedded in mortar matrix. Roughen joint to a full amplitude of minimum ¼-inch. Roughen concrete surface while concrete is still green where possible. Do not leave laitance, loosened particles of aggregate or damaged concrete at surface. Forms and reinforcing shall be cleaned of drippings.

D. Dampen contact surfaces of construction joints, leaving them free of standing water, before placing fresh concrete.

E. Form clean-out openings and removable sections shall be placed and secured only after inspection of forms.

3.4. MIXING CONCRETE

A. Ready Mix and Site Produced Concrete

1. Comply with ASTM C 94.
2. The batching plant shall be equipped with an electric metering device capable of determining moisture content of sand.
3. The addition of water at the site is contingent upon full time inspection of the process by the owners testing laboratory and the acceptance of the Inspector, Comply with ACI 301, section 4.3.2.1.
4. Begin the mixing operation within thirty minutes after the cement has been intermingled with the aggregates.

B. Lightweight Concrete: Mix lightweight concrete in accordance with the directions of the approved lightweight aggregate manufacturer.

3.5. PLACING CONCRETE

A. Inspection: Do not place concrete until forms and reinforcement as well as other required inspections have occurred and the Inspector is present to perform observations and tests during placing.

B. Before placing concrete remove snow, ice, frost, water, and other foreign material from surfaces, including reinforcement and embedded items against which concrete will be placed.

C. Method:

1. Convey concrete from mixer to place of final deposit by methods that will prevent separation and loss of materials. Do not use aluminum pipes or chutes.
2. Deposit concrete as nearly as possible to its final position to avoid segregation due to re-handling and flowing.
3. Place concrete at a consistency that allows proper placement and consolidation. Do not exceed the maximum specified slump.
4. Comply with ACI 301, Section 5.3.2.4
5. The unconfined vertical drop of concrete from the end of hoses or other conveying equipment to the placement surface shall not be greater than 10 feet for concrete containing High Range Water Reducing Admixture and 6 feet for all other concrete.

D. Sequence: Place concrete in columns, beams and joist stems prior to pouring concrete slabs.

E. Rate of Placement:

1. Place concrete at such a rate that concrete is at all times plastic and flows readily between bars.
2. When placing is once started, carry it on as a continuous operation until placement of the panel or section is complete. Construction joints to be made only where indicated on the Drawings or on approved shop drawings. Prevent the formation of cold joints at other locations.
3. Do not pour a greater area at one time than can be properly consolidated and finished without cracking or causing other problems. During hot or dry weather adjust the area as necessary.
4. Insure that concrete is in its final position within 1-1/2 hours after the introduction of the cement to the aggregates. In hot weather reduce this time limit so that no stiffening of the concrete shall occur until after it has been placed.

F. Weather Considerations

1. Follow the provisions of sections 5.3.1.5 and 5.3.1.6 of ACI 301.
2. Implement the cold weather procedures submitted prior to placing concrete when the temperature is less than 40 degrees F or is expected to drop below 40 degrees F in the following three days.
3. Temperature of the concrete shall not exceed 90 degrees F. Implement hot weather procedures as necessary to limit concrete temperature.
4. Comply with the temperature requirements of ASTM C94, section 4.2.2.7 of ACI 301, and section 5.3.2.1.c of ACI 301.
5. Comply with section 5.3.2.1.a of ACI 301.

G. A sample load of each of the specified mixes of strength equal or greater than for footings, may be poured in the foundation to check workability of the concrete.

H. Consolidation

1. Use all means necessary to provide fully filled out, smooth, clean, and properly aligned surfaces free from honeycomb,all pockets, planes of weakness, and unsightly blemishes.
2. During the pour, use suitable tools along the faces of the forms to force large particles away from the forms and to bring mortar to the surface of the forms.
3. Vibration shall be by means of mechanical vibrators in direct contact with the concrete, and not by vibrating the forms or reinforcing. Vibration shall continue until water shows the first sign of rising.
4. A mechanical vibrator shall be employed at each point of deposit. A stand-by vibrator in good working condition, but not in use, shall be kept on the job until all concrete is placed.
5. During placement when placing more than one layer of concrete, extend vibrator into the previous layer.
6. Workers shall be experienced in the use of vibrators. All vibrating operations of architectural concrete shall be performed by the same skilled person responsible for vibrating acceptable concrete in the mock-ups.

3.6. CONCRETE FINISHES AND TREATMENTS

A. General:
1. Take care that the concrete meets the screeds accurately and does not rise above or below them.
2. When placing concrete on metal deck, maintain top of slab at specified elevation adjusting for deflection in metal decking and steel beams.
3. Carefully provide slab depression as required for the finishes indicated on the Drawings.
4. Tolerances of all non-formed concrete finishes shall be in accordance with ACI 117.

B. Finishing Horizontal Surfaces:
1. Unless otherwise noted make all slabs even and uniform in appearance and, finish.
2. Finished floor tolerances to be measured as specified in section 4.8.5 of ACI 117. All finished floors shall achieve level tolerances of F_f 25/F_l 20 (F_f 35 for high-density storage on rails and areas to receive thin-set ceramic tile or vinyl tile). Floor levelness (F_l) criteria does not apply to elevated slabs on metal deck.
3. Where floor drains or floor slopes are indicated, slope slabs uniformly to provide even fall for drainage.
4. Unless otherwise noted, trowel all interior slabs to a troweled finish as per section 5.3.4.2.c of ACI 301.
5. Non-Oxidizing Metallic Floor Hardener:
   a. All slabs, in the loading dock area, or other areas noted on the drawings, shall receive an application of the non-oxidizing, metallic floor hardener applied at the rate of 1.5 lbs/ft^2. Immediately following the first floating operation, uniformly distribute approximately 2/3 of the required weight of the non-oxidizing metallic floor hardener over the concrete surface, by mechanical spreader, and embed by means of power floating. The hardener shall be floated in and the second application made. The surface shall be floated again to properly bond the hardener to the base concrete slab. The surface shall then be troweled, at least twice, to a smooth dense finish.
   b. After completion of broadcasting and floating, apply trowel finish as herein specified. Cure slab surface with curing compound recommended by hardener manufacturer. Apply curing compound immediately after final finishing.

6. Mineral Aggregate Hardener:
   a. All slabs, in areas noted on the drawings, shall receive an application of the mineral aggregate hardener applied at the rate of 1.2 lbs/ft^2. The hardener shall be applied in two applications by mechanical spreader. The first shake shall comprise 2/3 of the specified amount of hardener. This application shall be made after the initial floating operation unless climatic conditions dictate earlier application. The hardener shall be floated in and the second application made. The surface shall be floated again to properly bond the hardener to the base concrete slab. The surface shall then be troweled, at least twice, to a smooth, dense finish.
   b. After completion of broadcasting and floating, apply trowel finish as herein specified. Cure slab surface with curing compound recommended by hardener manufacturer. Apply curing compound immediately after final finishing.

C. Finish of Formed Concrete Surfaces
   1. Unless otherwise stated formed concrete surfaces shall have a smoothed formed finish. {how defined.

D. Finish of Flatwork
   1. Type of finish shall be in accordance with the architectural drawings.

E. Treatments and Repairs
   1. Repairs of Tie Holes.
      a. Immediately after form removal, form ties shall be removed from exposed surfaces, and holes shall be pointed flush with mortar composed of one part Portland Cement and one part sand.
      b. Except where form tie holes are to be left exposed, fill tie holes solid with patching mortar to match finish of adjacent surface.
   2. Repairs of Defects Other Than Tie holes.
      a. It is the intent of these specifications that the work will be of such quality that no patching of concrete will be required. In the event remedial patching is required, patch only areas designated by Architect.
      b. Prepare repair samples for Architect's approval at areas designated by Architect.
      c. Comply with provisions of section 5.3.7.3 of ACI 301.
      d. Slabs on Grade: After entire slab is finished any shrinkage cracks that are greater than 1/16 inch wide, shall be repaired.
      1). As approved by the Architect, fill cracks larger than 1/32 inch wide with cement grout and strike off level with surfaces.

F. Concrete Surfaces to Receive Cement Plaster: Lightly sandblast to remove loose material and roughen surface in preparation for cement plaster.

3.7. CURING CONCRETE

A. Curing shall comply with ACI 301 Section 5.3.6.

3.8. CONCRETE FILL

A. Install concrete fill on a continuous wire mesh of not less than 14 gage welded wire fabric, 2 in square, supported approximately ½ in above the bottom of pans. Screed concrete fill level and finish with wood float.

B. Screeding the concrete finish level, permit it to stand until it will bear the weight of workmen standing on boards. At this time the abrasive aggregate, having previously been soaked in clean water for about ten minutes, shall be sprinkled uniformly on the surface and immediately wood floated into the cement finish.

3.9. LIQUID DENSIFIERS, SEALERS AND DUSTPROOFING

A. Sealer/Dustproofer

1. Apply the specified sealer/dustproofer to exposed slabs subject to pedestrian traffic and as noted on the plans. Compound should be applied in strict accordance with the directions of the manufacturer just prior to completion of construction.
2. Apply according to manufacturer's instructions in a consistent manner to all surfaces.

B. Liquid Densifier/Sealer:

Apply the compound on exposed interior floors subjected to vehicular abrasion and shake on hardener slabs as indicated on the drawings.] [Apply to hardened concrete surfaces exposed to the elements that are not otherwise protected.] Application shall be made in strict accordance with the directions of the manufacturer and just prior to completion of construction. Spray, squeegee or roll on liquid densifier to clean, dry concrete surface. The liquid should be scrubbed into the surface with a mechanical scrubber. Keep the surface wet with the densifier during the application process. When the product thickens, but not more than 60 minutes after initial application, the surface shall then be squeegeed or vacuumed to remove all excess liquid.]

3.10. PROTECTION

A. During curing period protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock and excessive vibration.

B. Protect surfaces from damage due to paints, oils, rust or other stains and from impact damage.

3.11. GROUTING

A. Mix grout in accordance with the manufacturer's instructions to a consistency which will permit placement. Place grout in accordance with manufacturers recommendations. Place grout so as to ensure complete bearing and elimination of air pockets.

3.12. BASE PLATE GROUTING

A. The setting of steel base plates is specified under section 05 12 00 Structural Steel.

3.13. INSTALLATION OF EPOXY GROUTED ANCHORS

A. Holes to receive epoxy grouted reinforcing steel or threaded rods shall be drilled ¼-inch larger than the embedded item.

B. Install the grout according to the manufacturer's recommendations with due care given to cleaning hole prior to injection of grout.

C. Use care to insure that reinforcing steel or threaded rods to be embedded in epoxy grout are clean of oil and other substances that impact the bond to the grout.

D. Remove excess grout on the surface of the existing concrete. Use sandblasting or other mechanical means.

E. Use care when drilling holes so as not to cut existing reinforcing steel.

3.14. INSTALLATION OF CEMENTITIOUS GROUTED ANCHORS

A. Holes to receive cementitious grouted reinforcing steel or threaded rods shall be drilled with an annular space of ½-inch, i.e. hole diameter shall be 1 inch larger than the maximum diameter (e.g. out-to-out of bar deformations) of the embedded item.

B. Install the grout according to the manufacturer's recommendations with due care given to cleaning hole of all grease, oil, dirt and loose particles prior to placement of grout.

C. Saturate surface 24 hours just prior to grouting. Remove all free water prior to grouting. The surface shall be saturated surface dry at the time of grouting.

D. Install grout and anchors with due care to ensure continuous bonding between surfaces and that there are no voids in the grout.

E. Use care to ensure that reinforcing steel or threaded rods to be embedded in grout are clean of oil and other substances that impact the bond to the grout.

F. Remove excess grout on the surface of the existing concrete. Use sandblasting or other mechanical means.

G. Use care when drilling holes so as not to cut existing reinforcing steel.

3.15. CLEANUP

A. Remove all form release agents, bond breakers, curing compounds or other materials inconsistent with the specified finishes or that would prevent proper application of sealants, liquid waterproofing, or other finishes or treatments specified.

B. Clean all concrete surfaces that are to be exposed to view. Remove all cement and concrete droppings or splatters. Remove stains, and other discolorations which mar the appearance of the concrete.

C. Take care not to damage surrounding surfaces or leave residue from cleaning agents.

3.16. FIELD QUALITY ASSURANCE

A. General:

1. Notify the Architect and Testing Laboratory at least 48 hours prior to start of placement of concrete.
2. All testing specified in this section, including preparation of samples, shall be done by Testing Laboratory retained by the Owner.

3. The Testing Laboratory shall have free access to all places where concrete materials are stored, proportioned, or mixed and all materials, equipment, and methods used shall be subject to this inspection and test. Provide assistance as needed by the testing laboratory.
4. As a minimum, all testing and inspection as per the requirements of the International Building Code 2018 edition.
5. Sampling and Field Tests:
6. Take a sample from each 50 cubic yards of each grade of concrete or fraction thereof, or from each 2000 square feet of surface area for slabs or walks placed each day. No less than one sample to be taken for any one days operation. Each sample shall consist of:
   a. Five identical test cylinders made and stored in accordance with ASTM C-31.
   b. Slump test in accordance with ASTM C143 at point concrete is discharged into forms.
   c. Air entrainment test ASTM C173 or ASTM C231.
   d. Temperature of concrete and air.
   e. Water content in accordance with AASHTO TP23.
7. In addition to the normal samples make a slump test at 2-hour interval during concrete placement.
8. When shrinkage limit is specified take a shrinkage sample at the first pour for the mix design.

B. Testing:
1. Specimens to be cured in the laboratory in accordance with ASTM C 192 and tested in accordance with ASTM C 39.
2. Test two cylinders of each sample at 7 days for information and two cylinders at 28 days for acceptance. Keep the additional cylinder for later testing.
3. The strength level of the concrete will be acceptable if the averages of all sets of three consecutive 28 day strength tests results equal or exceed the specified strength, and no individual strength test result fall below the specified strength by more than 500 psi.
4. Test shrinkage in accordance with ASTM C-157.

C. Periodically inspect batch plant operations during production of concrete.

D. Notify Architect and Testing Laboratory when reinforcing steel or threaded rods are to be installed in grouted holes so the Testing Laboratory can observe work and proof test bars. A minimum of 25 percent of the bars or rods to be proof tested to 100 percent of specified yield.

END OF SECTION 033000

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units to reconstruct and finish interior masonry openings.
2. Brick.
3. Mortar and grout materials.
4. Reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Accessories.
8. Mortar and grout mixes.

B. Work of this Section also includes repair of existing masonry site walls including:
1. Repairing brick masonry.
2. Replacing damaged brick units or units removed for new Work.
3. Repointing brick masonry

C. Products Installed but not Furnished under This Section:
1. Steel lintels in unit masonry including:

D. Related Requirements:
1. Section 042000 “Unit Masonry” for coordination and removal of masonry required to create new masonry openings and accommodate new through wall flashing.
2. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:
1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.

C. Samples for Initial Selection:
   1. Clay brick masonry, in the form of sample boards or straps of five or more bricks.
   2. Colored mortar.
   3. Weep/cavity vents.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type of the following:
   1. Masonry units.
      a. Include data on material properties, material test reports substantiating compliance with requirements.
      b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
      c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.
   2. Cementitious materials. Include name of manufacturer, brand name, and type.
   3. Mortar admixtures.
   4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   5. Grout mixes. Include description of type and proportions of ingredients.
   6. Reinforcing bars.
   7. Joint reinforcement.
   8. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
   2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602.

D. Cold-Weather and Hot-Weather: Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches (610 mm) down both sides of walls, and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide standard square-edged and bullnose units unless otherwise indicated.
      a. Provide bullnose units to match existing glazed masonry units

B. CMUs: ASTM C90, normal weight.

   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
   2. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less than nominal dimensions.

2.2 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

B. Clay Face Brick: Brick shall match existing in size, color and texture.
1. Size (Actual Dimensions): 3-5/8 inches high by 7-5/8 inches long.
2. 

2.3 MORTAR

A. Prepackaged mortar (ready mix) complying with ASTM C 1142, or site-mixed portland cement mortar complying with ASTM C 270 may be used.

B. Admixtures are not permitted except where expressly specified herein or as otherwise approved by Architect for specific field conditions.

C. Color and texture: As approved by the Architect.

D. Mortar materials for site mixed mortar:
1. Portland cement for masonry conforming to ASTM C 150, Type I, non-staining, without air entrainment. Use Type III as necessary for laying masonry in cold weather.
2. For manufactured stone masonry, use white color portland cement.
3. For concrete masonry, use gray color portland cement

E. Aggregates for manufactured stone mortar: Clean sand, washed uniformly well graded, conforming to ASTM C 144, except for joints 1/4 inch and down use aggregate with 100 percent passing a No. 16 sieve.

F. Aggregates for grout: Conforming to ASTM C 144 for fine aggregate and ASTM C 404, Size 8 or 89.

G. Aggregate for concrete masonry mortar: Clean, washed uniformly well graded sand conforming to ASTM C 144, with the following graduation, and having a fineness modulus between 2.15 and 2.35:
1. Sieve Size Percentage Passing
2. #4..... 100%
3. #8..... 95 to 100%
4. #16..... 70 to 100%
5. #30..... 40 to 75%
6. #50..... 10 to 35%
7. #100..... 2 to 15%
8. #200..... 0 to 5%

H. Mortar pigments: Commercial alkali-resistant, non-fading mortar pigments, oxides of iron where feasible, synthetic type, equal to products of
1. Davis Colors, Beltsville MD.
2. Solomon Grind-Chem Service, Inc., Springfield IL.
3. Landers Segal Color, Inc., Passaic New Jersey.

I. Lime: Approved brand of plastic hydrated lime, conforming to ASTM C 207, Type “S”.

J. Water: Clean and fresh without contaminants.

K. Prepackaged mortar (ready mix)
1. General: complying with ASTM C 1142, factory blended consisting of:
   a. Portland cement: Comply with ASTM C 150, Type I.
   b. Hydrated lime: Type S, complying with ASTM C 207.
   c. Aggregate: Provide clean, sharp, well graded aggregate free from injurious amounts of dust, lumps, shale, alkali, surface coatings, and organic matter, and complying with ASTM C144.
   d. Admixtures: Prepackaged mortar mixes contain manufacturer’s own proprietary admixtures; additional field admixtures are strictly prohibited.
   e. Water: Provide water free from deleterious amounts of acids, alkalis, and organic materials. Water shall be potable.
   f. Pigments: Chemically inert synthetic iron oxide pigments, lightfast, weather resistant, complying with ASTM C-979.
   g. Mortar Color: As selected by Architect from manufacturer’s full range of standard colors.

L. Mortar types:
1. Mortar for masonry below grade or in contact with earth: ASTM C 270 type M using the property specification.
2. Mortar for load bearing masonry: ASTM C 270 type M [S] using the property specification.

3. Mortar for non-load bearing masonry above grade: ASTM C 270 type N using the property specification.
4. Mortar for pointing, dirt and stain resistant type: ASTM C 270 type N using the property specification with added aluminum tristearate, calcium stearate, or ammonium stearate to a quantity of 3 percent of Portland cement weight.

M. Integral water-repellent admixture: Integral liquid polymeric admixture mixed with mortar unit to provide resistance to water penetration.
1. Acceptable products (must be of same type and manufacturer as used for production of concrete masonry units):
a. Addiment, Inc., Doraville, GA, product “Mortar Tite”.
b. Forrer Industries (W.R. Grace & Company). “Dry-Block”.
c. Master Builders, product “Omnicron”.
d. Sonneborne, product “Hydrocide Powder”.
e. Chem-Masters Inc., product “Hydrolox 400”.

2.4 GROUT MIXES

A. Prepackaged grout (ready mix) complying with ASTM C 1107, or site-mixed Portland cement grout complying with ASTM C 476 may be used.

B. Grout for setting equipment, anchor bolts, elevator guide rails, structural steel elements and miscellaneous metals: Non-metallic high-strength controlled expansion grout of flowable consistency, having a compressive strength of 6,500 pounds per square inch (44.8 MPa) at 28 days; slump 8 to 10 inches.
1. Five Star Products, Inc., Fairfield CT, product “Five Star Grout”.
2. L&M Construction Chemicals, Omaha NE, Product: “Crystex”.
3. Master Builders, Cleveland, OH., product “Masterflow 713”.
4. Sika Corporation, Lyndhurst, NJ., product “SikaGrout 212”.
5. Sonneborn Building Products, Minneapolis, MN., product “Sonogrout 10K”.
6. Symons Corporation, DesPlaines, IL., product “Symons Multi-Purpose Grout”.

C. Grout for engineered masonry (core fill): Course grout having a compressive strength of 2,000 to 2,250 pounds per square inch (13.8 to 15.5 MPa) at 28 days; slump 8 to 10 inches.

D. Grout for bond beams and lintels: Fine grout having a compressive strength of 2,500 to 3,000 pounds per square inch (17.2 to 20.6 MPa) at 28 days; slump 8 to 10 inches.

2.5 EMBEDDED FLASHING MATERIALS

A. Flexible Stainless Steel Flashing where flexible flashing is indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Hohmann & Barnard, Inc.
b. Prosoco
c. York Flashings
d. Or approve equal
e. A self-adhering stainless steel fabric flashing product with a removable release liner for easy application. The clear adhesive is factory-laminated to a Class A

material consisting of a layer of polymeric fabric with a single sheet of Type 304 or 316 stainless steel bonded to one side.

2.6 REINFORCEMENT AND ANCHORAGE MATERIALS

A. Single wythe longitudinal reinforcement for concrete masonry unit walls and partitions: in overall width 1-5/8 inches less than the overall wall thickness, as manufactured by Dur-O- Wal, Hohmann, AA Wire, or equal.
   1. Interior partitions: Truss design, 9 gage ASTM A 641 class 1 galvanized wire.
   2. Exterior partitions: Truss design, 9 gage ASTM A 641 class 3 hot dipped galvanized wire.
   3. Provide preformed reinforcing sections at intersections of masonry walls and partitions, and whenever walls and partitions change direction.

B. Reinforcing steel, additional to rods which are embedded in concrete: Solid steel reinforcing bars, conforming to ASTM A 615, Grade 60, hot dipped galvanized in accordance with ASTM 123, B2 finish, of sizes indicated on the Drawings.

C. Corrugated-Metal Ties at Replacement Brick Veneer: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 0.3 to 0.5 inch (7.6 to 12.7 mm) and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm) made from 0.031-inch- (0.79-mm-)thick, stainless steel sheet
   1. Fastener Screws: Stainless Steel

2.7 ACCESSORIES

A. Compressible filler for joints at tops of non-load bearing masonry partitions, and for expansion joints in masonry walls: Closed cell Neoprene or PVC foam board, soft grade, 25 percent thicker than joint width, continuous in length, and in width to fill the joint to a point 3/4 inch back from each face of wall or partition.

B. Weep/Cavity Vents: Use the following unless otherwise indicated:
   1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3.2 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

C. Cleaning solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.8 MIXING MORTARS AND GROUT

A. General: Mix mortar and grout in accordance with the requirements of ASTM C270, and ASTM C476 as applicable.

B. Control batching procedure to ensure proper proportions by measuring materials by volume. Amount of mixing water and mortar consistency shall be controlled by mason.

C. Control batch sizes to allow for use within manufacturer’s recommended pot life.

D. Retempering will be permitted only within the first two hours of initial mix or shorter times as directed by manufacturers.

E. Discard all mortar and grout which exceeds the time limits allowed by the manufacturer. Discard mortar that has partially set.

F. Maintain sand uniformly damp immediately before mixing process.

G. Add mortar color and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.

H. Do not use anti-freeze compounds to lower the freezing point of mortar or grout.

I. Pouring grout shall be fluid consistency (as fluid as possible for pouring without separation of constituent parts).

2.9 SOURCE QUALITY CONTROL

A. Preconstruction testing: Except for testing by the Contractor, required as part of this Section, or Section 01 40 00 Quality Requirements, the Owner will employ and pay a qualified independent testing laboratory to perform the following preconstruction testing indicated as well as other inspecting and testing services required by referenced unit masonry standard or indicated herein for source quality control:
   1. Concrete Masonry Unit Tests: For each different concrete masonry unit indicated, units will be tested for strength, absorption, and moisture content per ASTM C 140.
   2. Mortar composition and properties will be field evaluated per ASTM C 780 for compressive strength, consistency, mortar aggregate ratio, water content, air content, and splitting tensile strength.
   3. Grout compressive strength will be tested per ASTM C 1019 for compressive strength and slump.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

C. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

D. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of

E. Fill cores in hollow CMUs with grout 24 inches (610 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

F. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.4 MORTAR BEDDING AND JOINTING

A. Lay CMUs as follows:
1. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.5 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to concrete and masonry backup masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
3. Space anchors not more than 16-inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (152 mm).

3.7 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches (203 mm) at each jamb unless otherwise indicated.

3.8 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections. Allow inspectors access to work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

3.10 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

3.11 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

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SECTION 050513 – FACTORY APPLIED COATINGS FOR METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies factory-applied metal coatings to provide Hot-Dip Galvanizing Finish

B. Fabricator may have hot-dip galvanizing applicator provide primer coat at fabricator's option.

C. Related Sections
1. 055000- Metal Fabrications
2. 055313-Bar Gratings
3. 055319-Expanded Metal Gratings

1.3 SUBMITTALS

A. Product Literature for Factory-Applied Metal Coatings: Submit galvanizer's product data sheets for coatings specified in this Section including physical performance test data.

B. Certificate of Compliance for Items Coated by Galvanizer: If requested, submit notarized Certificate of Compliance with invoice for galvanizing, signed by the galvanizer, indicating compliance with requirements of specifications. Include scope of services provided, and quantity and itemized description of items processed.

C. Certificate for review of for Shop Drawing Review by Galvanizer: If requested, submit galvanizer's certification that shop drawings for metal fabrications to receive metal coatings have been reviewed and that fabrications are acceptable to galvanizer for proper application of galvanizing and metal coatings. All drawings shall be signed by the galvanizer to indicate acceptance of design for galvanizing.

D. Certificate of Compliance of Item Identification by Galvanizer: If required, the galvanizer shall mark all lots of material with a clearly visible tag indicating the name of the galvanizer, the type of coatings, and the applicable ASTM standards. If requested, submit certification of compliance that items have been tagged.

E. Galvanizer shall have a written Quality Control/Quality Assurance manual for hot dip galvanizing and factory applied coating.

F. Certification from the American Galvanizers Association that Galvanizer has completed all course requirements and has a certified Master Galvanizer on staff.

1.4 QUALITY ASSURANCE

A. Galvanizer's Qualifications: Engage the services of a qualified galvanizer who has demonstrated a minimum of ten years' experience in the successful application of galvanized coatings specified in this specification in the facility where the work is to be performed.

B. Coordination between Fabricator and Galvanizer: Prior to fabrication and final submittal of shop drawings to Architect, direct fabricators to submit shop drawings to the galvanizer for all metal fabrications to receive factory-applied metal coatings. Direct galvanizer to review fabricator's shop drawings for suitability of materials for galvanizing and coatings and coordinate any required modifications to fabrications required to be performed by the fabricator.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN

A. Coating Applicator: For the purpose of establishing a standard of quality and performance, provide factory-applied metal coatings by Duncan Galvanizing, 69 Norman Street, Everett, MA, 02149, telephone 617-389-8440, fax 617-389-2831, www.duncangalvanizing.com.
   1. Duragalv® Hot-dip galvanizing for iron and steel fabrications.
   2. Option: Primergalv® Hot-dip galvanizing and factory-applied high performance polyamide epoxy primer for iron and steel fabrications.

2.2 GENERAL

A. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process. Galvanizing bath shall contain special high grade zinc and other earthly materials.
   1. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware.
   2. Provide thickness of galvanizing specified in referenced standards.
   3. Fill vent holes after galvanizing, if required, and grind smooth.
   4. Galvanized surface shall be prepared per SSPC SP2 or SP3 to provide a smooth surface removing all runs, drips or sags.
   5. Galvanizing shall exhibit a rugosity (smoothness) of 25 microns or less when measured by a profilometer. Profilometer shall be capable of operating in .1 micron increments. This pertains to those elements that are less than 24 pounds per running foot.

B. Factory-Applied Primer Option over Galvanized Steel: Provide factory-applied polyamide epoxy prime coat over hot-dipped galvanized steel.
   1. Basis-of-Design: PRIMERGALV®.
   2. Primer shall be certified OTC/VOC compliant at less than 2.8 lbs./gal. and conform to EPA and local requirements.
   3. Apply primer within 12 hours after galvanizing or blasting at the same galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer. Primer shall have a one year re-coat window for application of finish coat.

4. Polyamide epoxy primer shall be applied at 4-6 mils DFT and meet or exceed the following performance criteria as stipulated by the coatings manufacturer:
   a. Abrasion Resistance: ASTM D 4060 (CS17 Wheel, 1,000 grams load) 1 kg load, 200 mg loss.
   b. Adhesion: ASTM D 4541, 1050 psi.
   c. Corrosion Weathering: ASTM D 5894, 13 cycles, 4,368 hours, 10 per ASTM D 714 for blistering; 7 per ASTM D 610 for rusting.
   d. Direct Impact Resistance: ASTM D 2794, 160 in. lbs.
   e. Flexibility: ASTM D 522, 180 degrees bend, 1-inch mandrel, Passes.
   f. Pencil Hardness: ASTM D 3363, 3H.
   g. Moisture Condensation Resistance: ASTM D 4585, 100 degrees F, 2000 hours, Passes no cracking or delamination.
   h. Dry Heat Resistance: ASTM D 2485, 250 degrees F.
   i. Accelerated Weathering: QUV- ASTM D 4587 QUV A 5000 Hours Passes.
   j. Salt Fog Resistance: ASTM B 117, 5,600 hours No cracking or blisters

C. Warranty: Provide galvanizer's standard warranty that materials will be free from 10 percent or more visible rust for 20 years.

D. MISCELLANEOUS MATERIALS Galvanizing Repair Paint: MIL-P-21035B or SSPC-Paint 20. Provide
   1. ZIRP Zinc Rich Cold Galvanizing Compound
   2. ZRC Cold Galvanizing Repair Compound
   3. Or equal

PART 3 - EXECUTION

3.1 APPLICATION OF FACTORY-APPLIED METAL COATINGS

A. Galvanizing Application: Galvanize materials in accordance with specified standards and this specification. The dry kettle process shall be used to eliminate any flux inclusions on the surface of the galvanized material.

B. Prior to galvanizing, the steel shall be immersed in a flux solution (zinc ammonium chloride). The flux tank must be 12 to 14 Baumé density and contain less than 0.4 percent iron. Use of the wet kettle process is not acceptable. To provide the galvanized surface required, the following procedures shall be implemented:
   1. A monitoring recorder shall be utilized and inspected regularly to observe any variances in the galvanizing bath temperature.
   2. The pickling tanks shall contain hydrochloric acid with an iron content less than 12 percent and zinc content less than 3 percent. Titrations shall be taken weekly at a minimum.
   3. All chemicals and zinc shall be tested at least once a week to determine compliance with ASTM standards. All testing shall be done using atomic absorption spectrometry or x-ray fluorescence (XRF) equipment at a lab in the galvanizing facility.

C. Factory applied primer option: Finish coatings shall be applied under the following conditions.

1. Minimum air temperature shall be 50 degrees F. Surface temperature of steel shall be 50 degrees to 120 degrees F and, in any event, be 5 degrees F higher than the dew point. Humidity shall be 85 percent maximum.
2. The use of iron, steel shot, and aluminum oxide grit as a blast medium, and power wire brushes are not permitted.
3. Surface of substrate shall be dry and free from dust, dirt, oil, grease or other contaminants. Coating and cure facility shall be maintained free of airborne dust and dirt until coatings are completely cured.

3.2 INSTALLATION

A. Installation: Comply with fabricator's and galvanizer's requirements for installation of materials and fabrications, including use of nylon slings or padded cables for handling factory-coated materials.

B. Touch-Up and Repair: For damaged and field-welded metal coated surfaces, clean welds, bolted connections and abraded areas.
   1. For galvanized surfaces, apply organic zinc repair paint complying with requirements of ASTM A 780, modified to 95 percent zinc in dry film. Galvanizing repair paint shall have 95 percent zinc by weight. Basis of design is Zirp by Duncan Galvanizing. Thickness of applied galvanizing repair paint shall be not less than coating thickness required by ASTM A 123 or A 153 as applicable.
   2. Touch-up of galvanized surfaces with silver paint, brite paint, or aluminum paints is not acceptable.
   3. For factory-applied finish coatings, field-touch-up shall be performed by factory approved personnel for warranties to apply. Touch-up shall be such that repair is not visible from a distance of 6 feet. A touch-up repair kit and touchup instructions shall be provided to the Owner for each type of factory-applied finish upon request.

END OF SECTION 050513

SECTION 051200 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1. SUMMARY

A. Section Includes

The structural steel as shown on the drawings and specified herein, including, but not limited to, the following:

1. Girders and beams.
2. Columns and diagonal bracing.
3. Miscellaneous steel shown on the structural drawings.
4. Grouting of base plates, leveling and bearing plates.
5. Bolts and other steel accessories.

B. Related Sections

1. 031000 – Concrete Forming and Accessories.
2. 032000 – Concrete Reinforcing.
3. 033000 – Cast-in-Place Concrete.
4. 05 90 20 – Welding Details (Architectural assemblies)

1.2. REFERENCES

A. American Institute of Steel Construction (AISC).

1. AISC 360 - “Specification for Structural Steel for Buildings”.
2. AISC “Code of Standard Practice for Steel Buildings and Bridges”.

B. Research Council on Structural Connections (RCSC).

1. RCSC “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".

C. American Society for Testing and Materials (ASTM)

1. ASTM A6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use".
2. ASTM A27 "Specification for Steel Castings, Carbon, for General Application".
3. ASTM A36 "Specification for Carbon Structural Steel".
4. ASTM A53 "Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless".
5. ASTM A148 "Specification for Steel Castings, High Strength, for Structural Purposes".
6. ASTM A153 "Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware".
7. ASTM A307 "Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength".

8. ASTM A325 "Specification for Structural Bolts, Steel, heat Treated, 120/105 ksi Minimum Tensile Strength ".
9. ASTM A449 "Specification for Quenched and Tempered Steel Bolts and Studs".
10. ASTM A490 "Specification for Heat-Treated, Steel Structural Bolts, 150 ksi Minimum Tensile Strength".
11. ASTM A500 "Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes".
12. ASTM A501 "Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing".
13. ASTM A514 "Specification for High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding".
14. ASTM A563 "Specification for Carbon and Alloy Steel Nuts".
15. ASTM A992 "Standard Specification for Steel for Structural Shapes for Use in Building Frame".
16. ASTM A588 "Specification for High-Strength Low-Alloy Structural Steel with 50 ksi Minimum Yield Point to 4 in Thick".
17. ASTM A618 "Specification for Hot-Formed and Seamless High-Strength Low-Alloy Structural Tubing".
18. ASTM A687 "Specification for High-Strength Nonheaded Steel Bolts and Studs".
19. ASTM A913 “Standard Specification for high-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST).
20. ASTM B695 “Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
21. ASTM F436 "Specification for Hardened Steel Washers".
22. ASTM F959 "Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners".

D. American Welding Society (AWS).
1. AWS D1.1 “Structural Welding Code - Steel".

E. American Association of State Highway and Transportation Officials (AASHTO).
1. AASHTO "Standard Specifications for Highway Bridges".

F. Structural Steel Painting Council (SSPC).
1. SSPC "Steel Structures Painting Manual, Volume 2, Systems and Specifications".

1.3. SUBMITTALS

A. Shop Drawings:
1. Prepare complete shop drawings showing anchor rod setting plans, details of layout, fabrication, and erection.
a. Indicate the materials used and beam marks.
b. Reference shop drawings to specific location and detail number on the Drawings.
c. Show extent of painting .

d. Indicate location and type of special finish requirements, including grinding of welds. Indicate architecturally exposed steel.

e. Copies of the Contract Documents will not be considered as meeting these requirements.

2. Provisions of AISC Code of Standard Practice for Steel Buildings and Bridges related to shop and erection drawings are applicable.

3. Submit shop drawings to Architect for review and obtain acceptance prior to start of fabrication.

4. Prior to submitting erection drawings submit plans of all levels showing dimensioned location of edge of slab, deck, and openings.

5. Submit fabricators identification mark system prior to fabrication.

B. Mill Reports

1. Submit copies of certified mill test reports for each heat of steel and for all fasteners, including nuts and washers prior to start of fabrication.

2. Mill test reports shall include ladle analysis and tensile elongation and bend tests. Perform mechanical and chemical tests for all material regardless of thickness or use.

3. Along with mill reports submit tests results of Charpy V-notch tests when Charpy V-notch criteria is specified.

4. Mill reports shall be traceable to individual pieces of steel used.

5. In addition to other requirements mill reports shall address the following elements: copper, columbium, chromium, nickel, molybdenum, silicone, and vanadium.

6. Provide mill reports for all welding consumables used on this project.

C. Submit certificates of compliance for:

1. Welding electrodes

2. Shear studs including manufacturers test reports.

3. Welder have passed qualification tests.

D. Welding Procedure Submittals:

1. Submit written Welding Procedures Specifications (WPSs) in accordance with AWS D1.1 requirements for each different welded joint proposed for use whether prequalified or qualified by testing. The manufacturer and specific electrode shall be stated in the WPS. Manufacturer and specific electrode shall be considered essential variables for the WPS.

2. In addition to the Welding Procedure Specifications submit fabrication and erection procedures where needed to control shrinkage, fabrication tolerances, or to insure proper inspection.

3. Procedure Qualification Record (PQR) in accordance with AWS D1.1 for all procedures qualified by testing.

4. Electrode manufacturers data.

5. When larger effective throat thicknesses of flare groove welds than allowed by Table J2.2 of AISC “Specification for Structural Steel for Buildings Allowable Stress Design and Plastic Design”, submit data establishing by qualification the consistent production of of

such larger effective throat thicknesses. Qualification of effective throat thicknesses shall be as prequired by the AISC specification.

6. The WPS and PQR will be reviewed by the Testing Laboratory for conformance with the requirements of AWS D1.1.

E. Connection Design

1. The Contractor is responsible for the design of connections when they are not fully defined on the contract documents.
2. At the commencement of the project submit a letter signed and sealed by the Engineer that will supervise the steel connection design attesting to this responsibility.
3. At the end of the steel shop drawing submission phase submit a letter, signed and sealed by the Engineer supervising the steel connection design, attesting to the completion of the work.
4. Submit calculations of all connections. Calculations and details shall be clearly keyed to the appropriate members on the construction documents. Calculations shall bear the seal of the Engineer supervising design the of steel connections.
5. Contractor shall not proceed with steel erection until these requirements are fulfilled.

1.4. QUALITY ASSURANCE

A. Qualifications: Design of structural steel connections to be under the direct supervision of a Professional Engineer experienced in the design of such components and registered in the State of Massachusetts, and shall conform to the applicable national, state and city standards.

B. Owner's Testing Laboratory: Shop and field testing and inspection of steelwork specified in this document or requested by the Owner will be performed by an independent laboratory engaged by the Owner ("Inspector").

C. All work shall be performed by qualified operators experienced in their field of work and as otherwise required by these specifications.

D. Qualifications of Welders:

1. Qualify welders in accordance with AWS D1.1 for each process, position, and joint configuration. Each operator shall have been qualified as prescribed by AWS. Welder qualification shall include passing the bend test and Charpy tests when Charpy values are specified for the electrode.
2. Require welders to retake the qualification test if, as determined by the Architect, there is a reasonable doubt as to the proficiency of the welder. If the welder does not requalify, he shall not perform any welding on the project.
3. Pay all costs associated with welder qualification.

E. MOCK-UP

1. Provide a full size mock-up of architecturally exposed steel if specified. Mock-up shall be representative of the finished work in all respects. Replace unsatisfactory work as direct. Mock-up shall be provided at the fabricator's plant. Mock-up assembly will be used as a standard for judging acceptability of work on project.
2. Apply finished paint system specified herein and in Section 09 90 00 "Painting" to exposed surfaces of mock-up.

3. After acceptance transport mock-up to job site and erect where directed. Provide foundation and bracing as required to maintain mock-up in a stable condition until completion of the work. Paint bracing and touch-up mock-up.

1.5. DELIVERY, STORAGE AND HANDLING

A. Store materials to permit easy access for inspection and identification. Support steel members off ground. Protect steel members and packaged materials from corrosion and deterioration. Materials showing evidence of damage will be rejected and shall be immediately removed from the site.

B. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

C. Do not handle structural steelwork until paint has thoroughly dried. Care shall be exercised to avoid abrasions and other damage.

D. All fasteners and washers shall be delivered to the site, where they will be installed, in unopened containers.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Steel Shapes, Bars, and Plates:

1. ASTM A992 Gr. 50 for all “W” shapes unless noted otherwise on drawings.
2. ASTM A36 for: “M”, “S”, “C”, “MC”, “L” and bars and plates and where noted on drawings.
3. ASTM A913 Gr. 50 where noted on drawings with a maximum yield stress of 65ksi. In addition the Additional Tension Test, Ultrasonic Examination, Maximum Carbon Equivalent, and Fine Austenite Grain Size as included in the added supplemental requirements shall apply.
4. ASTM A913 Gr. 65 where noted on drawings. In addition the Additional Tension Test, Ultrasonic Examination, Maximum Carbon Equivalent, and Fine Austenite Grain Size as included in the added supplemental requirements shall apply.
5. Members that are noted as a part of moment frames, braced frames, eccentrically braced frames, or spliced in tension:

a. ASTM A6 Group 3, 4 and 5 rolled shapes or plates more than 2 inches thick shall conform to Section A3.1.c of “Specification for Structural Steel Buildings”, March 9, 2005 except that a Charpy V-Notch value of 20 ft.-lb at [21] degrees C is specified.

6. Rotary straightening shall not be used to straighten columns unless ASTM A913 steel is specified.
7. Weathering Steel: ASTM A588 Grade A or B unless otherwise shown. Use one (1) grade throughout.

B. Square, Rectangular and Round Tubing: ASTM A500 Grade B

C. Pipe: ASTM A53, Type E or S, Gr. B

D. Steel Castings: ASTM A27, Grade 65-35, Class 1 or ASTM A 148 Gr. 80-50, carbon steel as noted on Drawings.

E. Shear Studs or Headed Studs: Comply with AWS D1.1 Section 7 for type B studs (Table 7.1). Length noted is the installed length.

F. Welding Electrodes:

1. Conform to AWS D1.1. Base selection of electrodes on the actual properties of the metal connected.
2. Electrodes shall have a specified minimum tensile strength of at least 70 ksi.
3. Use low hydrogen electrodes.
4. For all welds in special moment frame connections (where noted on drawings), electrodes shall have minimum Charpy values of 20 ft. lb. and a minimum average value of 20 ft. lb. at 0°C.
5. Electrodes for Weathering Steel: Conform to base metal manufacturer's recommendations for strength, atmospheric corrosion resistance and weathered appearance which shall match the base metal.

G. Metallic Filler: Plastic Steel Putty manufactured by Devcon Corporation.

2.2. FASTENERS

A. Unfinished Bolts and Nuts (Machine Bolts) and Threaded Rods:

1. Bolts and Nuts: ASTM A307, Grade A
2. Washers: ASTM F844

B. High Strength Bolts Nuts and Washers: ASTM A325 Type 1 except use Type 3 bolts where ASTM A588 material is specified, Use ASTM A490 Type 1 bolts where noted.

C. Anchor Rods: ASTM F1554 unless otherwise noted.

D. Where fasteners are indicated as galvanized, provide units that are zinc coated in accordance with ASTM B 695, Class 50

E. Direct Tension Indicators: ASTM F 959, Type as required, at Contractor's option.

F. Expansion Bolts: Kwik-Bolt III as manufactured by Hilti Inc. or approved alternate.

G. Clevises and Turnbuckles: Dimensions and minimum capacities to conform to the values listed in Tables 8-27 and 8-29 of the “AISC Steel Construction Manual.”

H. Sleeve Nuts: Strength of sleeve nut shall be such that when loaded axially the sleeve nut shall be stronger than the ultimate capacity of the connected parts.

I. Recessed-Pin Nuts: Dimensions and minimum capacities to conform to the values listed in the “AISC Steel Construction Manual.”

J. Cotter Pins: Dimensions and minimum capacities to conform to the values listed in the “AISC Steel Construction Manual.”

2.3. PRODUCTS

A. Bearings

1. Sliding Bearing Pads as indicated, one of the following: Seismic Energy Products "Fluorogold"; Lubrite Division, Merriman Inc "Lubrite"; The Duriron Co Inc. "Riload".
2. Elastomeric Bearing Pads: Comply with AASHTO "Standard Specifications for Highway Bridges", Section 18, Durometer as shown.

B. Paint

1. Shop Paint: SSPC, Paint 20, Type I, Inorganic, or Type II, Organic. Paint shall comply with the requirements of SSPC-PS 12.01.
2. Primer paints shall be compatible with finishes specified by the architect.

C. Grout

1. Nonmetallic Shrinkage-resistant Grout: Premixed, nonmetallic, non-corrosive, nonstaining product containing selected silica sands, Portland Cement, shrinkage compensating agents, plasticizing and water-reducing agents. Subject to compliance with requirements, provide: BASF MasterBuilders "MasterFlow 713" or Five Star Products "Five Star Grout".
2. Non-Shrink Grout: Premixed non-shrink, non corrosive compound consisting of non-metallic aggregate, cement; water reducing and plasticizing agents capable of developing minimum compressive strength of 2,400 psi in 48 hours and 6,000 psi in 28 days; "Five Star Grout" manufactured by Five Star Products.
3. Drypack: Euclid Chemical Company “Euco Dry Pack Grout”, BASF MasterBuilders “MasterFlow 700”, or equal. Mix to a plastic consistency.

2.4. CONNECTION DESIGN

A. Contractor shall design all steel connections not fully defined.

B. Type of Connections

1. All connections shall be one of the following:
   a. High-strength bolts.
   b. Unfinished bolts.
   c. Welds.
2. When the type of connection is shown on the drawings use that type of connection.
3. Use a connection other than unfinished bolts where required by code and in the following locations:
   a. All connections indicated as such.
   b. Connections that are a part of the lateral force resisting system.
   c. Connections for supports of running machinery or of other live loads which produce impact.

d. Connections carrying cooling tower loads.

e. Beams supporting columns or posts.

f. Connections for cantilevers.

g. All column splices.

C. Design Criteria.

1. Design connections for the loads and according to the requirements in the Contract Documents and the applicable building regulations.

2. Connections shall be adequate to provide for the reaction due to the maximum uniformly distributed load that the beam is capable of carrying for its span, based on the allowable unit stresses, except where other reactions are shown on the Drawings.

3. Minimum connections shall comply with appropriate tables headed “Framed Beam Connections” shown in the AISC “Manual of Steel Construction.” Seated connections may be used only when they do not interfere with architectural features.

4. Bolts shall be at least 3/4 inches in diameter.

2.5. FABRICATION

A. General:

1. Fabrication to be performed in accordance with Chapter M of AISC "Specification for Structural Steel Buildings", the AISC “Code of Standard Practice for Buildings and Bridges” sections 3.2, 5, 6, 8 and the Drawings and Specifications.

a. Assume all thermally cut edges are subject to substantial stresses.

b. Paragraph M4.6 shall be considered deleted from Chapter M.

c. The last sentence of paragraph M5.1 shall be deleted from Chapter M.

2. Provide holes and accessories required for securing other work to the work specified here.

3. Where thickness of material exceeds 7/8 inch or the diameter of hole, drill or ream holes after punching even when punching is allowed by referenced standards. Flame cut holes for fasteners are not acceptable.

4. Fabricate beams and girders with natural camber upward, unless otherwise shown or indicated on the Drawings.

5. Splice members only where indicated on Structural Drawings or where accepted by the Architect.

6. Remove burrs that would prevent solid seating of the connected parts.

7. When bending steel plate:

a. Bend plates perpendicular to the rolling direction.

b. Grind flame cut plate edges transverse to the bend line.

c. Grind out nicks in plate edges transverse to the bend line.

d. Round sharp corners on plate edges transverse to the bend line.

8. Weld sizes where shown shall be assumed to be the effective weld sizes.

B. Architecturally Exposed Steel

1. All members exposed to view in the completed structure shall be classified as "Architecturally Exposed Structural Steel".
2. Comply with the provisions of the AISC Code of Standard Practice for Steel Buildings and Bridges regarding architecturally exposed structural steel.
    a. Abutting cross sectional configurations shall match.
    b. Remove backing bars.
    c. Remove weld runoff tabs and grind smooth.
    d. All surfaces and welds exposed to view shall be treated as finished surfaces.
3. Exposed Welds:
    a. All exposed fillet welds shall be made smooth of uniform convex contour, radius and dimension for their full length; grind smooth, if welds were not made to this criteria.
    b. All other exposed welds shall be milled or ground smooth and flush with the surfaces of the adjoining materials welded.
4. Weld show-through shall not be permitted.
5. Remove weld splatter on architecturally exposed steel.
6. All exposed corners shall be square and sharp, eased to a radius of 1/4 in.

C. Bolting, General:
1. Bolts shall be of a length that will extend not more than 1/4 in beyond the nuts unless noted otherwise.
2. Washers shall be used on Bolts. Use beveled washers where bolts bear on sloping surface.
3. Bolts shall be installed such that no threads occur in the shear plane when joining pieces 3/8” thick and thicker.
4. Manufacturers symbol and grade markings shall appear on all bolts and nuts.
5. Product containers must be marked so that correspondence with mill reports can be established.
6. Holes in column baseplates shall be oversized per Section 14 of AISC Manual of Steel Construction, latest edition.
7. Circular and slotted holes shall be as per Specification for Structural Joints Using ASTM A325 or A490 Bolts. For purposes of hole fabrication assume dynamically loaded connections.
8. When bolt holes are subject to welding shrinkage stresses the holes shall be drilled.

D. Unfinished Bolts (Machine Bolts) and Anchor Rods:
1. Install and tighten unfinished bolts in accordance with requirements for snug tightened bolts as defined in “Specification for Structural Joints Using ASTM A325 or A490 Bolts”.
2. Mutilate bolt threads for unfinished bolts to prevent the nuts from backing off.

E. High-Strength Bolts

1. Install high-strength threaded fasteners in accordance with RCSC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts". Contact surfaces of bolted parts shall as a minimum comply with the class A requirements.
2. For slip critical (friction) type connections, tighten nuts using Direct Tension Indicator. Calibrated wrench and "Turn of Nut" methods are not acceptable.
3. When connection has bolts and welds, tighten bolts prior to welding with the exception that in moment connections the flange welds are completed prior to final tightening of high strength bolts.
4. When already tensioned bolts have had their tension relaxed, either re-torque the bolts using a calibrated wrench or replace the bolt and tension indicator and re-tighten.

F. Welding

1. Welding shall be in accordance with AWS D1.1 "Structural Welding Code".
   a. Contractor is responsible for selection of specific materials and procedures except as specifically noted in contract documents.
   b. Connections have varying levels of restraint and thus necessary steps shall be taken by Contractor to control or accommodate the restraint.
   c. Welding and fabrication procedures shall incorporate measures necessary to eliminate cracking. These measures shall include but are not limited to additional preheat, postheat, or retarded cooling.
   d. When selecting materials and procedures, consideration shall be given to the need for materials and procedures in excess of code requirements.
   e. The need for pre-heat and other procedures are to be based on the actual chemistry and mechanical properties of the steel and not solely on the specified properties of the steel.
   f. Limit maximum interpass temperatures so as not to decrease toughness and strength of the weld metal.
   g. Weld variables shall be consistent with the recommendations of the electrode manufacturer.
   h. Welding Procedure Specifications shall be readily available to all welders, inspectors, and supervisors during the production process.
   i. Weld only in accordance with the WPSs.
   j. Do not mix different electrodes in the same weld joint unless the interactions have been shown not to cause problems.
   k. Welding procedures shall incorporate low hydrogen practices.
   l. Use stringer beads only (no weaving).
2. No tack welds not incorporated into a weld will be allowed on the finished structure with the exception of backing plates that are not removed.
3. All groove or butt welds shall be full penetration unless noted otherwise on the Drawings.
4. Do not weld into the column flange to column web intersection.
5. Sequence the work as necessary to accommodate testing.
6. Remove run-off tabs and backup plates and grind surfaces smooth as required for inspection or testing.

7. At connections of members that are a part of "special moment frames" or "eccentrically braced frame":
    a. Remove backing bars and apply reinforcing fillet weld per note J of figure 2.4 of AWS D1.1.
    b. Remove weld runoff tabs and grind smooth.
    c. Delete "...root and ..." from subsection 4.14.1.5 of AWS D1.1
    d. Limit oscillation of FCAW electrodes to 3d, for d >= 3/32 inches, and to 5d, for d < 3/32 inch (d = wire diameter)
    e. Pay increased attention to uniform and adequate preheat.
    f. Maximum interpass temperature not to exceed 550 degrees F when notch toughness properties are specified.
    g. Complete individual weld layers prior to applying portions of subsequent layers. Ends of interrupted passes to be staggered. Minimize starts and stops within body of the weld.
8. Splices of members in tension, members of moment frames, members of braced frames, and members of eccentrically braced frames that are made from ASTM A6 Group 4 of 5 rolled shapes, and or plates more than 2 inches thick shall be made in conformance with Section J1.5 of "Specification for Structural Steel Buildings".
9. Shear Studs: Install shear studs in accordance with the manufacturer's recommendations and AWS D1.1.
10. Where tubes, pipes or other closed sections are exposed to the weather, provide seal welds where other specified welds do not provide a complete seal of the enclosed space.

G. Finishes of Architecturally Exposed Steel
1. All surfaces of architecturally exposed structural steel members shall be uniform in appearance, including smoothness and texture, when viewed in direct sunlight at a distance of 10 feet, at angles of incidence 0 degree to 90 degree at completion of the following stages of work:
    a. "Surface Preparation" and "Shop Prime Painting,".
2. Surface Appearance: The initial condition of steel to be exposed in use shall conform to SSPC-Vis 1 Rust Grade A. The exposed surfaces, edges and ends of all plates and other components shall be free of any surface defects including weld splatter, burrs, dents, gouges, occlusions, streak, ridges and recesses. Such defects may be repaired and surface restored with weld or other approved filler material and machining (milling, grinding or sanding) to match appearance, including smoothness and texture, of parent surface.

H. Shop Painting
1. All structural steel exposed to the weather, classified as Architecturally Exposed Steel, or not completely concealed by interior finishes shall receive a shop coat of primer except as follows:
    a. Steel in contact with concrete or cementitious fireproofing.
    b. Contact surfaces of welded connections and areas within 4 in on each side of field welds.
    c. Machined surfaces.
    d. Contact surfaces of high-strength bolted connections.

e. Reinforcing steel.

f. Exterior exposed surfaces of weathering steel.

2. Steel members not otherwise painted shall be painted when subjected to condensation from piping, are in shower or steam rooms, are exposed to chemical fumes or are exposed to other conditions of potentially aggressive corrosion.

3. The following surfaces shall be temporarily protected by a thin coating of varnish or lacquer:

a. Unpainted area around field welds.

b. Steel around high strength bolts.

c. Machined surfaces.

4. Surface preparation and application shall be in accordance with SSPC-PS 12.01 “One-Coat Zinc-Rich Painting System”.

2.6. SOURCE QUALITY CONTROL

A. Testing and inspection of structural steelwork will be performed by the Testing Laboratory. Provide the Inspector with the following:

1. A complete set of accepted "Submittals"

2. Cutting lists, order sheets, material bills, and shipping bills

3. Representative sample pieces as requested by the testing agency

4. Full and ample means and assistance for testing all material.

5. Access and facilities, including scaffolding, temporary work platforms, etc., for testing and inspection at all places where materials or components are stored or fabricated, and also in their erected position.

B. Scheduling of Tests and Inspections

1. The Contractor shall notify the Inspector in sufficient time prior to fabrication or erection work to allow testing and inspection without delaying the work.

2. Shop welds will be inspected in the shop before the work is painted or shipped.

C. Each person installing connections shall be assigned an identifying symbol or mark and all shop and field connections shall be so identified so that the Inspector can refer back to the person making the connection.

D. Non-destructive Testing and Inspections

1. As a minimum the inspector will make all tests and inspections as required by the International Building Code 2018 edition. The Inspector will make all the tests and inspections indicated in the Construction Documents.

2. The Inspector will make all verification tests and inspections as required by AWS D1.1 "Structural Welding Code".

3. Do not reduce testing frequency unless permission is obtained from Architect.

4. Inspector shall be present during all welding operations.

5. Verify that welders are certified.

6. Check materials, equipment and procedures. Verify meters on welding equipment are functioning and are accurate.
7. Visual Inspection:
    a. Visually inspect all welds.
    b. Visual inspection of multi-pass welds to be continuous.
    c. Visually inspect welds to Group 4 and 5 sections of at least 72 hours after completion of welding for the presence of cracks.
    d. Verify the effective throat thickness of flare groove welds is consistently obtained when flush to bar or section. This verification shall be based on test sections where necessary.
8. Test Methods:
    a. Butt welds will be tested using magnetic partical test methods and either ultrasonic or radiographic test methods.
    b. Butt welds to pipes and tubes to be tested using magnetic particle tests.
    c. Use magnetic partical test methods for filet welds and to supplement the testing requirements for butt welds.
    d. For radiographic a double film technique will be used. One copy of each film will be sent to the Architect, the other will be retained by the Inspector.
    e. In addition to the non-destructive testing specified other non-destructive test methods recognized by AWS D1.1 may be used at the Architects discretion and the results can be used to reject work under this contract.
9. Frequency of non-destructive examination is to be as follows:
    a. Full Penetration Butt Welds: 100 percent ultrasonic.
    b. Partial Penetration Butt Welds: 50 percent min. ultrasonic or radiographic inspection.
    c. Fillet and other welds not otherwise inspected: a minimum of 20 percent.
    d. Selection of welds to be examined: Where there is a requirement for less than 100% examination the method of selection of welds to be examined is to be agreed with the Architect before commencement of the work. If the Architect does not provide more specific criteria inspectors will select the welds to be tested. The inspectors will chose specific weld so as to obtain results that are representative of the conditions in the structure. In addition inspectors will emphasize those locations that experience has shown are more likely to have problems.
    e. On five percent of the full penetration butt welds (as chosen by inspector) at connections denoted as being a "special moment connection" as noted on the drawings, after removing, run-off tabs, grind the end of the weld sufficiently to allow determination of number and sizes of weld passes.
10. Testing of Base Metal: These provisions are in addition to other applicable requirements.
    a. For full penetration welds where they are part of moment frame or eccentrically braced frames the edges of material to be welded will be ultrasonically examined for evidence of laminations, inclusions or other discontinuities.
    b. Ultrasonically test column flanges and webs at the location of all moment connections and brace connections. Test for a distance 3 inches around the

location to be welded. The test procedure and acceptance criteria is defined by ASTM A898-07, “Standard Specification for Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes” Level I.

c. Base metal thicker than 1-1/2 inches, when subjected to through-thickness weld shrinkage strains, shall be ultrasonically inspected for discontinuities behind and within a distance of 3 inches of such welds after joint completion. Any material discontinuities shall be accepted or rejected on the basis of the defect rating in accordance with flaw severity, Class B criteria in Table 8.2 in AWS D1.1.

11. Where inspection reveals unacceptable defects:

a. The extent of inspection will be increased to provide confidence that the defects in a joint has been found and to assure that the problem is not systematic.

b. As a minimum, examine two additional joints in the group represented by the joint. If the non-destructive examination of the two additional joints reveals unacceptable defects, examine each joint in the group.

E. Take samples of all welding consumables and store in sealed containers.

F. Tests of High Strength Bolts, Nuts and Washers:

1. The Inspector will make all tests and inspections of high strength bolt connections as required by RCSC "Specifications for Structural Joints Using High Strength Bolts".

2. Observe all Direct Tension Indicators to see if proper tightness was achieved.

3. Confirm that the faying surfaces have been properly prepared before connections are assembled.

G. Testing of End-Welded Studs:

1. End-welded studs shall be random sampled and tested from stock furnished to each project. Tests shall meet the requirements in Table 7.1 of AWS D1.1.

2. Production control testing shall be in accordance with AWS D1.1 Chapter 7.

3. As a minimum, visually inspect 100% of the installed studs and test 15% of installed studs in accordance with AWS D1.1 paragraph 7.8.

H. Inspection Records

1. Make systematic record of all welds, including:

a. Location and type of weld.

b. Identification marks of welders.

c. List of defective welds.

d. Manner of correction of defects.

2. The Inspector will maintain a daily record of the work that has been inspected and its disposition. One copy of each of the report will be submitted to the Owner on a weekly basis. Test reports will be made on the form suggested in the AWS D1.1 "Structural Welding Code."

I. Mill Reports: Testing laboratory will review mill reports for conformance to referenced standard.

PART 3 - EXECUTION

3.1. CONDITION OF SURFACES

A. Prior to commencing with the erection of structural steel inspect the job site and verify that the structural steel may be erected in accordance with the Drawings and Specifications.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Architect in writing.
2. Do not proceed with construction in the region of the discrepancy until all such discrepancies have been resolved.

3.2. PREPARATION

A. Secure field measurements required for proper and adequate fabrication and installation of the work covered in this Section. Assume responsibility for exact measurements.

B. Furnish templates for exact locations of items to be embedded in concrete [and masonry,] and any setting instructions required for installation.

C. Contractor to employ an engineer or surveyor to check elevations of concrete bearing surfaces, anchor rods locations, and similar devices before erection proceeds. Report discrepancies to the Architect. Do not proceed with erection until corrections have been made or until compensating adjustments to structural steel work have been agreed upon with the Architect.

3.3. ERECTION

A. General:

1. Structural steel shall be erected in accordance with Chapter M of AISC Specifications and the Drawings and Specifications and with the AISC Code of Standard Practice.
2. Erection of architecturally exposed structural steel shall be in accordance with Section 10.5.1 and 10.5.2 of AISC Code of Standard Practice for Steel Buildings and Bridges.
3. Dimensions shown on drawings are based on an assumed design temperature of 70 degree F. Fabrication and erection procedures shall take into account the ambient temperature range at the time of the respective operations.
4. Care shall be taken to protect work already installed from damages resulting from structural steel erection.
5. Steel erection may be allowed prior to supporting concrete reaching specified strengths if the contractor provides technical justification and the Architect concurs.

B. Temporary Shoring and Bracing:

1. Provide temporary bracing and shoring adequate to protect the structure against damage due to construction loads and other loads such as wind and seismic forces.
2. Provide temporary works as necessary to erect the structure.
3. Items installed before concrete is placed shall be properly braced to prevent distortion by pressure of concrete. Watch and maintain bracing during concrete operations.
4. Contractor is responsible for identifying need for temporary construction.

C. Field Assembly:

1. Set structural members to the lines and elevations indicated. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
2. Before assembly clean bearing surfaces and other surfaces which will be in permanent contact after assembly.
3. Do not enlarge unfair holes in members by burning or by the use of drift pins. Ream holes that need to be enlarged to admit bolts. Where a hole is required to be enlarged by more than 3/32-inch ream to and use next larger bolt size.
4. Do not use gas cutting torches in the field for correcting fabricating errors in the structural framing unless accepted by the Architect. Finish gas cut sections equal to a sheared appearance when permitted.
5. The quality of field welds or bolting shall be the same as that performed in the shop.
6. Erection bolts for welded connection shall be tightened securely and left in place.
7. Erection Bolts: On architecturally exposed steel construction, remove erection bolts, fill holes with plug welds, and grind exposed surfaces smooth.

D. Installation of Bearing Pads:

As per manufacturer’s instructions.

E. Setting Base Plates:

1. Prepare surface of existing concrete as if for a concrete construction joint. Clean the bottom surface of base plates.
2. Grout shall be non-shrink grout mixed and applied in strict accordance with the manufacturer’s directions.
3. Leave no voids between the base plate and the concrete.
4. Tighten anchor rods after the supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the base plate prior to installing grout.

F. Expansion Bolts:

1. Install in accordance with the manufacturer's recommendations.
2. Use washers on all bolts.
3. Use care to avoid cutting or damaging reinforcing bars.
4. When exposed to view in the final structure, bolts shall be of a length that will extend entirely through but not more than 1/4-inch beyond the nuts unless otherwise shown on the Drawings.

G. Shear Studs shall be attached in accordance with requirements of AWS D1.1 "Structural Welding Code".

3.4. BASE PLATE GROUTING

A. Base plate grout shall be mixed and applied in strict accord with manufacturer's directions.

B. Leave no voids between the base plates and the concrete.

3.5. TOUCH-UP PAINTING

A. Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint, and paint all surfaces exposed to the elements with the exception of those surfaces in direct contact with concrete or fireproofing.

B. Use same materials and standards as for shop painting.

3.6. FIELD QUALITY CONTROL

A. All field welding shall be inspected by a full time inspector.

B. Field quality control shall, as a minimum, conform to the requirements specified under Source Quality Control.

C. Expansion bolts to be proof tested after installation by loading 25 percent of them to 150 percent of the manufacturers recommended tensile design loads.

END OF SECTION 051200

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SECTION 053000 – METAL DECKING

PART 1 - GENERAL

1.1. SUMMARY

A. Section Includes - Fabrication and installation of metal decking and metal decking accessories.

B. Related Sections
   1. 033000 – Cast-In-Place Concrete.
   2. 051200 – Structural Steel Framing.
   3. 052100 – Steel Joists Framing.
   4. 055000 – Metal Fabrications.
   5. 078100 – Applied Fireproofing.

1.2. REFERENCES

A. American Iron and Steel Institute (AISI).
   1. AISI “Specification for the Design of Cold Formed Steel Structural Members.”

B. American Society for Testing and Materials (ASTM).
   1. ASTM A1008A.
   2. ASTM A653.
   3. ASTM A36 "Specification for Carbon Structural Steel".

C. American Welding Society (AWS).
   1. AWS D1.3 “Specifications for Welding Sheet Steel in Structures".

D. Underwriters Laboratories Fire Resistance Directory.

1.3. SUBMITTALS

A. General:
   1. Submit shop drawings for review and obtain acceptance prior to start of fabrication.
   2. Review of submittals is for general conformance with the design concept of the project and information shown on the contract documents only. The Contractor is responsible for conforming, correlating and coordinating dimensions in the field for tolerance, clearances, quantities, fabrication and installation processes means and methods of construction, coordination of this work with other trades and performing work in a safe and satisfactory manner.

B. Product Data:

1. Submit manufacturer's literature for each style and combination of deck assembly provided including steel decking design calculations, section properties, load carrying capacity, deflection data, and load test data substantiating calculated capacities.
2. Submit U.L. Fire Rating Report.
3. Submit certified copies of mill test reports for each heat of steel and for all fasteners, including nuts and washers prior to start of fabrication.
4. Mill test reports shall include ladle analysis and tensile elongation and bend tests. Perform mechanical and chemical tests for all material regardless of thickness or use.
5. Mill reports shall be traceable to individual pieces of steel used.

C. Shop Drawings:
1. Prepare decking plans showing deck profile, sheet layout, method of attachment, edge details, supplemental framing, openings and reinforcement, projections and accessories.
2. Show type and location of welds and other fasteners.
3. Show where shoring of deck is needed.

D. Submit certificates of compliance for:
1. Welding electrodes including electrode specification sheets.
2. Shear studs including manufacturers test reports.
3. Welder has passed qualification tests.

E. Welding Procedures:
1. Submit welding procedures for all welding.

1.4. QUALITY ASSURANCE

A. Owner's Testing Laboratory: Testing and inspection of metal decking will be performed by an independent laboratory engaged by the Owner ("Inspector").

B. All work shall be performed by qualified operators experienced in their field of work and as otherwise required by these specifications.

C. Qualifications of Welders:
1. All welding shall be performed by operators who are qualified for the types of welds used. Each operator shall have been qualified as prescribed by AWS. Welder qualification shall include passing the bend test.
2. Require welders to retake the qualification test in, as determined by the Architect, there is a reasonable doubt as to the proficiency of the welder. If the welder does not requalify, he shall not perform any welding on the project.
3. Pay all costs associated with welder qualification.

1.5. DELIVERY, STORAGE AND HANDLING

A. Store materials to permit easy access for inspection and identification. Support material off the ground and protect from corrosion and deterioration. Materials showing evidence of damage will be rejected and shall be immediately removed from the site.

B. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

C. Where deck is exposed to view in the completed structure use special care to prevent damage to decking.

D. Each bundle of decking shall be marked or tagged to indicate material grade, style and gage of deck.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Metal Decking

1. ASTM [A 1008A] [A 653-09 designated as Structural Steel grade 50 or higher with [G60] [G90] coating.].
2. All decking shall have a current ICC listing allowable vertical load values, diaphragm shear values and ratings for use in fire resistive assemblies.
3. Decking shall be coated with the manufacturers painted finish where a galvanized finish is not provided.
4. Decking Manufacturer: Canam or accepted equal.

B. Accessories:

1. Cover plates, flashings and closures: Sheet steel ASTM A 653 Grade G60 or ASTM A 611 Grade C to match deck material, 16 gage minimum.

C. Welding Electrodes:

1. Conform to AWS D1.3 and deck manufacturers recommendations. Base selection of electrodes on the actual properties of the metal connected.
2. Electrodes will have a specified minimum tensile strength of at least 60 ksi.
3. Use low hydrogen electrodes.

2.2. PRODUCTS

A. Touch-up Paint.

1. Where painted decking is used touch-up paint shall be same as recommended by the decking manufacturer.
2. Touch up paint for galvanized sheet metal shall be Steel Structures Painting Council (SSPC) Paint-20 Type 1, Inorganic.]

2.3. FABRICATION

A. Fabricate deck units in lengths to span three or more spans where possible.

B. Cantilevered units shall have the cantilever and at least the adjacent span in one length.

C. Fabricate such that end joints occur over supporting members.

D. Sheets parallel to and at the perimeter of the deck shall be full width sheets.

E. Each bundle of fabricated elements shall be marked or tagged so as to show material and grade.

F. TOLERANCES:

1. Panel length: Plus or minus ½ inch.
2. Thickness of deck units: Not less than 95 percent of the specified thickness.
3. Panel camber: ¼ inch in 10 foot length.

PART 3 - EXECUTION

3.1. CONDITION OF SURFACES

A. Prior to commencing with the erection of structural steel inspect the job site and verify that the work is sufficiently complete that this installation may properly commence.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Architect in writing.
2. Do not proceed with construction in the region of the discrepancy until all such discrepancies have been resolved.

3.2. PREPARATION

A. Secure field measurements required for proper and adequate fabrication and installation of the work covered in this Section. Assume responsibility for exact measurements.

3.3. ERECTION

A. General: Install deck units and accessories in accordance with Construction Documents and manufacturer's recommendations.

B. Placing Deck Units:

1. Position on supporting members and adjust to final position with ends bearing a minimum of 2 inches on supporting members.
2. Where feasible, install with ribs at right angles to support members.
3. Place units end-to-end before permanently fastening.
4. Align ribs over entire length of run.
5. Shore and brace decking as necessary for all construction loads.

C. Fastening of Deck Units:

1. Welding shall be in accordance with AWS D1.3.
    a. Contractor is responsible for selection of specific materials and procedures except as specifically noted in contract documents.

b. When selecting materials and procedures, consideration shall be given to the need for materials and procedures in excess of code requirements.

c. Weld variables shall be consistent with the recommendations of the electrode manufacturer.

d. Welding Procedure Specifications shall be readily available to all welders, inspectors, and supervisors.

2. No tack welds not incorporated into a weld will be allowed on the finished structure with the exception of backing plates that are not removed.

3. Sequence the Work as necessary to accommodate testing.

4. Secure decking to supporting members with [3/4]-inch diameter puddle welds. If studs are welded through the deck to the structural steel the stud welds can replace the fusion welds on a one per one basis.

5. Use weld washers when base metal thickness is less than 0.028 inch or where required in the Construction Documents. Weld washers shall have a minimum thickness of 16 gage and have a nominal 3/8 inch diameter hole.

D. Closures:

1. Install sheet steel closures and angle flashings to close openings between decks and walls, columns, and opening.

2. Closures shall be of sufficient strength to remain in place without significant distortion. Shore where necessary.

E. [Punch holes in bottom flutes as required for installation of hanger wires.]

F. [Where the underside of decking is exposed in the final structure.

1. Tape or otherwise seal joints to prevent leakage of concrete.

2. Prevent damage to deck that would be observed.]

G. Cutting Openings:

1. Where openings do not need reinforcements (exclusive of trim bars in concrete) do not cut deck until concrete has cured.

2. Unless both edges of openings perpendicular to deck span are supported by a beam, do not cut opening until concrete has cured.

3.4. PROTECTION

A. Contractor is responsible for determining of the adequacy of the decking (with or without concrete fill) to support construction loads and for identifying need for temporary construction. Shoring is the responsibility of the Contractor.

B. Do not suspend ducts, piping, ceilings, light fixtures or other items from metal roof decking.

C. Do not place pipes or conduit in concrete fill over deck except as specifically allowed.

D. Decking shall be protected from damage during construction operations. As a minimum this shall include the use of planked runways if buggies are used.

E. Concrete admixtures containing chloride salts shall not be used in concrete fill placed on metal decking.

3.5. TOUCH-UP PAINTING

A. Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint, and paint all surfaces exposed to the weather in the complete structure.

B. Use same materials and standards as for shop painting.

3.6. CLEAN-UP

A. Remove grease, oil, and other foreign material from all surfaces.

B. Leave deck in proper condition for bonding with concrete fill where concrete fill will be placed.

3.7. FIELD QUALITY CONTROL

A. Testing and inspection of metal deck installation will be performed by the independent testing agency. Provide the Inspector with the following.

1. A complete set of accepted "Submittals"
2. Representative sample pieces as requested by the testing agency
3. Full and ample means and assistance for testing all material.
4. Access and facilities, including scaffolding, temporary work platforms, etc., for testing and inspection at all places where materials or components are stored or fabricated, and also in their erected position.

B. Scheduling of Tests and Inspections: The Contractor shall notify the Inspector in sufficient time prior to fabrication or erection work to allow testing and inspection without delaying the work.

C. Non-destructive Testing and Inspections

1. As a minimum the inspector will make all tests and inspections as required by the International Building Code 2018 edition. The Inspector will make all the tests and inspections indicated in the Construction Documents.
2. The Inspector will make all verification tests and inspections as required by AWS D1.3.
3. Inspector shall be present during all welding operations.
4. Verify that welders are certified.
5. Check materials, equipment and procedures. Verify meters on welding equipment are functioning and are accurate.
6. Visually inspect all welds.

D. Inspection Records

1. Make systematic record of all welds, including:
   a. Location and type of weld.
   b. Identification marks of welders.

c. List of defective welds.

d. Manner of correction of defects.

3. The Inspector will maintain a daily record of the work that has been inspected and its disposition. One copy of each of the report will be submitted to the Owner on a weekly basis. Test reports will be made on the form suggested in the AWS D1.3.

E. Mill Reports: Testing laboratory will review mill reports for conformance to referenced standard.

END OF SECTION 053000

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Metal ladders.
3. Ships Ladders
4. Wire Mesh metal gates
5. Wire Mesh metal grille
6. Metal downspout boots.

B. Products furnished, but not installed, under this Section include the following:
1. Loose steel lintels.

C. Related Requirements:
1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:
1. Fasteners.
2. Shop primers.
3. Metal downspout boots.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
1. Metal ladders.
2. Loose steel lintels.

1.4 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.2 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and where indicated, flat washers.

C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ISO 3506-1); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 2 (A4).

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
   1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

F. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless steel bolts, ASTM F593 (ISO 3506-1), and nuts, ASTM F594 (ASTM F836M).

2.3 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

D. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing[and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.5 METAL LADDERS

A. General:
1. Comply with ANSI A14.3.

B. Vertical Steel Ladders:
1. Space siderails 24 inches apart unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 1-inch-square, steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Provide nonslip surfaces on top of each rung by coating with abrasive material.
   a. Product by one of the following:
      1) Acry-Tech Coatings;
         a) https://www.acrytech.com/product-category/anti-slip-coatings/
      2) Southern Industrial Supply:
         a) https://southern-industrial.com/collections/anti-slip-safety-coatings/anti-slip-safety-coating
      3) Superior Industries, Inc. ;

a) https://www.superior-industries.com/products/safety-products/non-slip-coatings/traction-progrip-900.html

7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
8. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
9. Prime with zinc-rich primer

2.6 METAL SHIPS' LADDER

A. Provide metal **ships' ladders** where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Treads are not to be less than 5 inches (127 mm) exclusive of nosing and riser height is not to be more than 9-1/2 inches (241 mm).
2. Fabricate **ships' ladders**, including railings from **steel**.
3. Fabricate treads from **welded or pressure-locked steel bar** grating. Limit openings in gratings to no more than **1/2 inch** in least dimension.
4. Comply with applicable railing requirements in Section 055213 "Pipe and Tube Railings."

B. Galvanize **and prime** frame, including treads, railings, brackets, and fasteners.

2.7 WIRE MESH GATES AND COVERS

A. Provide wire mesh metal gates at stair locations indicated.
1. Frame shall be minimum 2-inch square tube steel sections, fully welded into configurations shown.
2. Provide enclosed hardware box, 3/16 -inch thick minimum steel sheet for mortise lockset installation as shown.
3. Mesh shall be 1 x 1 inch square, installed on the diagonal.
   a. 0.8800x 0.8800 inch opening
   b. Carbon Steel
   c. Fully welded
4. Coordinate fabrication with specified pivots and mortise locksets.
5. Galvanize **and prime** including frame, hardware boxes, and mesh.

B. Provide wire mesh grate and frame at air returns
1. Frame shall be minimum 1-inch steel angle sections, fully welded into configurations shown.
2. Provide mounting tabs, punched to receive fastner.
3. Mesh shall be 2 x 2 inch square, installed on the diagonal.
   a. Carbon Steel
   b. Fully welded
4. Shop p**rime** including frame, mounting tabs and mesh.

2.8 METAL DOWNSPOUT BOOTS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. J.R. Hoe & Sons Inc.
   2. JR Smith MFG. Co
   3. NEI Neehah Enterprises, Inc.

B. Source Limitations: Obtain downspout boots from single source from single manufacturer.

C. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
   1. Outlet: Vertical, to discharge into pipe; provide units with offsets to clear building elements
   2. Coordinate with site drainage work

D. Factory applied powder-coat finish

2.9 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.10 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.11 STEEL AND IRON FINISHES

A. Galvanizing: As specified in Section 050513

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

   1. Shop prime with universal shop primer.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF METAL LADDERS

A. Secure ladders to adjacent construction with the clip angles attached to the stringer.

B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

3.3 INSTALLING METAL MESH GATES AND FRAMES

A. Install gates and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings.

B. Align and hang gates to provide free swinging operation.

C. Install hardware and adjust.

3.4 INSTALLATION OF METAL DOWNSPOUT BOOTS

A. Anchor metal downspout boots to concrete or masonry construction to comply with manufacturer's written instructions.

B. Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

3.5 REPAIRS

A. Touchup Painting:
   1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
      a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Steel pipe railings and guard assemblies.
   2. Modifications to existing guard assemblies
   3. Opening protective
   4. Swinging gate guard

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, which are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer's product lines of mechanically connected railings.
   2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the State of Rhode Island

B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.3 STEEL AND IRON

A. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
1. Provide galvanized finish for exterior installations and where indicated.

B. Plates, Shapes, and Bars: ASTM A36/A36M.

2.4 FASTENERS

A. General: Provide the following:
1. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.5 HARDWARE

A. For swing gate at filter room areaway guard:
   1. Hinges: Two Truclose Heavy Duty Hinge by EZI Klamp or equal. https://eziklampsystems.com/product-category/handrail-gates-and-hinges/. Self-lubricating, round post model, adjustable, with stainless steel springs.
   2. Provide flat stop welded to vertical edge of gate. Stop shall be minimum of 2 x 3 inches with eased edges. Provide adhesively applied neoprene stop .
   3. Latch: provide latch welded to post , "Best Gate Latch" by Lieser Land Forge, LLC or equal https://www.bestgatelatch.com/store/p3/Weld_to_Metal_Post.html#/.

B. At Catwalk Railing provide the following:
   1. 1-inch diameter eyes welded to post aligned with horizontal rails. 4 total
   2. Two lengths of 5/64th type 304 stainless steel chain to drape between posts
   3. Stainless steel Trigger snaps to connect chain to eye loop
   4. Stainless steel quick links at each end of chain.

2.6 MISCELLANEOUS MATERIALS

A. Welding and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Non shrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

F. Anchoring Cement: Factory-packaged, non-shrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and related items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove flux immediately.
   4. At exposed connections, finish exposed surfaces smooth and blended, so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form Changes in Direction as Follows:
   1. As detailed.
   2. By bending.
   3. By radius bends of radius indicated.

J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

N. For railing posts set in concrete, provide steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.8 STEEL AND IRON FINISHES

A. Galvanizing: As specified in Section 050513

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or] anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
   1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

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SECTION 055313 - BAR GRATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal bar gratings.
2. Grating frames and supports.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Clips and anchorage devices for gratings.
2. Paint products.

B. Shop Drawings:

1. Include plans, sections, and attachment details.
2. Signed and sealed by the qualified professional engineer responsible for their preparation.

C. Delegated Design Submittals: For gratings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, which are to be embedded in concrete or masonry.

B. Welding certificates.

C. Delegated design engineer qualifications.

1.4 QUALITY ASSURANCE

A. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Rhode Island and who is experienced in providing engineering services of the type indicated.

B. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
1. AWS D1.1/D1.1M.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design gratings.

B. Structural Performance: Gratings to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Areaway Grating: Uniform load of 60 lbf/sq. ft. (2.87 kN/sq. m).
2. Elevated Platform at Filter Level: Uniform load of 100 lbf/sq. ft. (4.79 kN/sq. m).
3. greater stress.
4. Limit deflection to L/360 or 1/4 inch (6.4 mm), whichever is less.

2.2 METAL BAR GRATINGS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Ohio Gratings, Inc.; Series or comparable product by one of the following:
1. Borden Metal Products (Canada) Limited.
2. Grating Pacific, Inc.
3. Grupo Metelmex, S.A. de C.V.
4. IKG USA LLC.
5. Indiana Gratings, Inc.
6. Interstate Gratings.
7. Laurel Custom Grating LLC.
8. Lichtgitter USA, Inc.
9. Nucor Vulcraft.

B. Metal Bar Grating Standards: Comply with NAAMM MBG 531 and NAAMM MBG 532.

C. Welded Steel Grating at Filter Room

1. Bearing Bar Spacing: 1/2 inch o.c.
2. Bearing Bar Depth: 2-1/2 inches minimum, as required to comply with structural performance requirement].
3. Bearing Bar Thickness: 1/4 inch minimum, as required to comply with structural performance requirements.
4. Traffic Surface: Knurled.
5. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface.

D. Welded Steel Grating at Areaways
1. Bearing Bar Spacing: 15/16 inch o.c.

2. Bearing Bar Depth: As required to comply with structural performance requirements.
3. Bearing Bar Thickness: 3/16 inch minimum as required to comply with structural performance requirements].
4. Crossbar Spacing: 4 inches o.c.
5. Traffic Surface: Plain
6. Steel Finish: Hot-dip galvanized in accordance with ASTM A123/A123M with a coating weight of not less than 1.8 oz./sq. ft..
7.

2.3 GRATING FRAMES AND SUPPORTS

A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
   1. Unless otherwise indicated, fabricate from same basic metal as gratings.

B. Galvanize steel frames and supports in all locations.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, nuts, and, where indicated, flat washers; ASTM F593 (ISO 3506-1) for bolts and ASTM F594 (ASTM F836M) for nuts, Alloy [Group 1 (A1)] [Group 2 (A4)].

C. Post-Installed Anchors: Torque-controlled expansion or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
   1. Material for All Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ISO 3506-1), and nuts, ASTM F594 (ASTM F836M).

2.5 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Bars for Bar Gratings: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

2.6 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling

limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Provide for anchorage of type indicated, coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
1. Provide at least four weld lugs for each grating section containing rectangular bearing bars 3/16 inch (4.8 mm) or less in thickness and spaced less than 15/16 inch (24 mm) o.c., with each lug shop welded to three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.

H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

I. Do not notch bearing bars at supports to maintain elevation.

2.7 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Corrosion Protection: With a heavy coat of bituminous paint, coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals.

3.2 INSTALLATION OF METAL BAR GRATINGS

A. Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 REPAIR

A. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055313

SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Stainless steel exterior decorative railings.

1.2 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, which are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Fasteners.
   2. Nonshrink, nonmetallic grout.
   3. Anchoring cement.
   4. Metal finishes.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required.
   1. Sections of each distinctly different linear railing member, including handrails, top rails, and posts.
   2. Welded connections.

E. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For delegated design professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
   1. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
      b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.3 STAINLESS STEEL DECORATIVE RAILINGS

A. Source Limitations: Obtain stainless steel decorative railing components from single source from single manufacturer.

B. Tubing: ASTM A554, Grade MT 316.

C. Pipe: ASTM A312/A312M, Grade TP 316.

D. Castings: ASTM A743/A743M, Grade CF 8M or CF 3M.

E. Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 316

F. Flat Bar: ASTM A666, Type 316] [Type 316L.

G. Bars and Shapes: ASTM A276/A276M, Type 316

2.4 FASTENERS

A. Fastener Materials:
   1. Stainless Steel Railing Components: Type 316 stainless steel fasteners.
   2. Ungalvanized-Steel Railing Components: Plated-steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for electrodeposited zinc coating where concealed; Type 304 stainless steel fasteners where exposed.
   3. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.
   1. Provide Tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

   1. For stainless steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

C. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
   1. Clearly mark units for reassembly and coordinated installation.
   2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.
   1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
   2. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water.
   1. Provide weep holes where water may accumulate.
   2. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove flux immediately.
   4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds: ornamental quality with no evidence of a welded joint.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.

J. Provide inserts and other anchorage devices for connecting railings to concrete or masonry Work.
   1. Fabricate anchorage devices capable of withstanding loads imposed by railings.

K. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Stainless Steel Tubing Finishes:
1. 180-Grit Polished Finish: Uniform, directionally textured finish.

C. Stainless Steel Sheet and Plate Finishes:
1. Directional Satin Finish: ASTM A480/A480M, No. 4.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.
1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line, without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
5. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3 m).

B. Adjust railings before anchoring to ensure matching alignment at abutting joints.

C. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches (50 mm) beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches (150 mm) of post.

3.3 ANCHORING POSTS

A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement], mixed and placed to comply with anchoring material manufacturer's written instructions.

3.4 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

3.5 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION 057300

SECTION 057500 - DECORATIVE FORMED METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Decorative panels at lobby millwork, gymnasium entry, and entry soffit.
   2. Decorative metal base materials at lobby millwork and gymnasium entry.

B. Related Requirements:
   1. Section 062023 “Interior Architectural Woodwork” for panels installed with woodwork.
   2. Section 064116 “Plastic Laminate Clad Architectural Cabinets” for panels installed on face of cabinets

1.2 COORDINATION

A. Coordinate installation of anchorages for decorative formed metal items. Furnish setting drawings, templates, and directions for installing stand-offs and anchors.. Deliver items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for decorative formed metal.
   1. Include plans, elevations, component details, and attachment details.
   2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
   3. Coordinate shop drawings with Interior Woodwork and Plastic Laminate Clad Cabinet shop drawings.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch- (150-mm-) square Samples of metal of same thickness and material indicated for the Work.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For cleaning and maintenance of metal.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative formed metal similar to that indicated for this Project and with a record of successful in-service performance as well as sufficient production capacity to produce required units.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Store products on elevated platforms in a dry location.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. For decorative metal items, obtain each color, grade, finish, type, and variety of metal from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 SHEET METAL

A. Steel Sheet: Uncoated, cold-rolled, ASTM A1008/A1008M, commercial steel.

B. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 316 stretcher-leveled standard of flatness.

2.3 MISCELLANEOUS MATERIALS

A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide concealed fasteners for interconnecting decorative formed metal items and for attaching them to other work unless [otherwise indicated] [exposed fasteners are unavoidable or are the standard fastening method].
2. Provide [Phillips] [tamper-resistant] [square or hex socket] flat-head machine screws for exposed fasteners unless otherwise indicated.

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of decorative formed metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- (12-mm-) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (1 mm) and support with concealed stiffeners.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce decorative formed metal items as needed to attach and support other construction.

F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install decorative formed metal items.

G. Where welding or brazing is indicated, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

2.5 MILLWORK PANELS

A. Perforated Metal Panels
   1. Material: Uncoated steel
   2. Hole Pattern: ¼ inch round on 3/8 inch staggered joints.
   3. Hole Arrangement: 60 degree staggered centers
   4. Percent open area: 40 percent
   5. Thickness: 16 gage or 0.0598 inch
   6. Provide panels in size indicated.
   7. Panels shall have 1-inch +/- margin around panel perimeter
   8. Finish: Powder coat.
      a. To be selected from manufacturers full range

2.6 PANELS AT ENTRY SOFFIT

A. Perforated Metal Panels
   1. Material; Type 316 or 304 stainless steel
   2. Hole Pattern: ¼ inch round on 3/8 inch staggered joints.
   3. Hole Arrangement: 60 degree staggered centers

4. Percent open area: 40 percent
5. Thickness: 16 gage or 0.0625 inch
6. Provide panels in size indicated.
7. Panels shall have 1-inch +/- margin around panel perimeter

2.7 SHEET STEEL BASE AND TRIM

A. Solid Metal Panels
   1. Material: Uncoated steel sheet
   2. Thickness: 18 gage or 0.0478 inch
   3. Provide panels in size indicated.
   4. Finish: Powder coat.
      a. To be selected from manufacturers full range

2.8 GENERAL FINISH REQUIREMENTS

A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."

B. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating.

C. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.

   1. Color and Gloss: As selected by Architect from manufacturer's full range; semi-gloss

2.10 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

3.3 ADJUSTING AND CLEANING

A. Unless otherwise indicated, clean metals by washing thoroughly with water and soap, rinsing with clean water, and drying with soft cloths.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 057500

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SECTION 061000 – ROUGH CARPENTRY

PART 1 - SUMMARY

A. Section Includes:
   1. Wood-preservative-treated lumber.
   2. Fire-retardant-treated lumber.
   3. Dimension lumber framing.
   4. Miscellaneous lumber.
   5. Plywood backing panels.

B. Coordinate the Work of this Section with the Drawings notes on the Structural Drawings. The Structural drawings shall govern.
   1. Section 061600 "Sheathing" for sheathing,

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. Lumber grading agencies, and abbreviations used to reference them, include the following:
   1. NeLMA: Northeastern Lumber Manufacturers' Association.
   2. NLGA: National Lumber Grades Authority.
   3. SPIB: The Southern Pine Inspection Bureau.
   4. WCLIB: West Coast Lumber Inspection Bureau.
   5. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of processt. Indicate component materials and dimensions and include construction and application details.

   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
   3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.
   4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:
1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
4. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:
1. Boards: 19 percent.
2. Dimension Lumber: 19 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal .

2.2 PRESERVATIVE TREATMENT

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2[for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

2.3 FIRE-RETARDANT TREATMENT

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

2.4 DIMENSIONAL LUMBER MATERIALS

A. Lumber Grading Rules: NFPA, RIS, SPIB, WCLIB or WWPA.
   1. Beam, Joist & Rafter Framing: SPF Species, 1 or 2 grade, size as per drawings, 19 percent maximum moisture content.
   2. Non-structural Light Framing: SPF Species, 2 grade, size as per drawings, 19 percent maximum moisture content.
   3. Studding: SPF Species, 1 or 2 grade, size as per drawings, 19 percent maximum moisture content. “Stud” grade shall not be used.
   4. Wood in Contact with Exterior Masonry and Concrete: SYP Species, 1 or 2 grade, size as per drawings, 19 percent maximum moisture content, pressure preservative treated with alkaline copper quaternary (ACQ) with 60 pound per cubic foot (pcf) retention.
   5. Sills & Plates: SPF Species, 1 or 2 grade, size as per drawings, 5 percent maximum moisture content (kiln dried).
   6. Solid Posts and Beams: Hem Fir Species, 1 or 2 grade except as required for architectural finish considerations.
   7. Nailers & Blocking: SPF construction grade, finished 4 sides, 19% maximum moisture content, sizes as required by items being supported.

2.5 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Rooftop equipment bases and support curbs.
   4. Cants.
   5. Furring.
   6. Grounds.
   7. Utility shelving.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:
   1. Hem-fir (north); NLGA.
   2. Mixed southern pine or southern pine; SPIB.
   3. Spruce-pine-fir; NLGA.
   4. Hem-fir; WCLIB or WWPA.
   5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   6. Northern species; NLGA.

7. Eastern softwoods; NeLMA.

C. Utility Shelving: Lumber with 15 percent maximum moisture content of any of the following species and grades:
   1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Standard or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
   2. Mixed southern pine or southern pine; No. 1 grade; SPIB.

D. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
   1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
   2. Hem-fir or hem-fir (north); Construction or No. 2 Common, Standard or No. 3 Common grade; NLGA, WCLIB, or WWPA.
   3. Eastern softwoods; No. 2 Common grade; NeLMA.
   4. Northern species; No. 2 Common grade; NLGA.

E. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.

F. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C,fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.7 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
   1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Provide standard attachment hardware consisting of nails, bolts, screws and standard fittings as noted on the drawings and as required. Hardware for rough carpentry shall be as follows:
   1. Bolts and Nuts: AISI / ASME Standard B18.2.1
   2. Lag Screws: AISI / ASME Standard B18.6.1
   3. Steel Washer Plates: Same as above or ASTM A36 for custom sizes.
   4. Spikes: Galvanized, hardened steel conforming to Federal Specification FF-N-105B.
   5. Standard Connectors (where specified or allowed): Items as manufactured by the Simpson Strong-Tie Company of San Leandro, CA, or approved equal.
   6. Shear Plates: Hot Rolled Pressed Steel Type Satisfying SAE Standard 1010.
   7. Nails shall be Common Wire type, hot dip galvanized per ASTM A53 at exposed locations.

E. Provide standard framing hangers and accessories that are equal or equivalent to the Simpson products that are referenced on the drawings.

2.8 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets:
   1. Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

B. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

C. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 GENERAL FRAMING REQUIREMENTS

A. Comply with the following:
   1. Provide all framing in accordance with proper and standard practice, and all governing codes. Contractor shall be prepared to correct any unsuitable conditions per the direction of the Architect.
   2. Wood construction is to conform to "National Design Specification for Wood Construction", 2015 edition (NDS 2015).
   3. New lumber for structural use is to be surface dried and have a moisture content of not more than 19 percent.
   4. Wood construction shall conform to the Rhode Island State Building Code.
   5. Wood is to be handled and covered to prevent damage and moisture absorption from snow or rain.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

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SECTION 061600 - SHEATHING

PART 1 - GENERAL

A. Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Wall sheathing.
   2. Roof sheathing.

B. Related Sections:
   1. Section 06100- Rough Carpentry
   2. Section 072713 “Modified Bituminous Sheet Air Barrier” for air barriers applied to wall and roof sheathing behind insulation

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Wall sheathing.
   2. Roof sheathing.

B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   3. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:
   1. Fire-retardant-treated plywood.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 ROOF AND WALL SHEATHING

A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2, Exterior, Structural I sheathing.

B. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b for exterior construction not in contact with ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

C. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

2.2 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. For roof and wall sheathing, provide fasteners of Type 304 stainless steel

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 INSTALLATION OF WOOD STRUCTURAL PANEL

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:
   1. Wall and Roof Sheathing:
      a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
      b. Space panels 1/8 inch (3 mm) apart at edges and ends.

END OF SECTION 061600

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SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

1.1 SUMMARY

A. Section Includes:
1. Interior standing and running trim
2. Wood Feature Wall
3. Reception Desk and Wood Trim
4. Shop finishing of interior architectural woodwork to receive transparent finish.
5. Shop Priming of interior architectural woodwork to receive opaque finish.
6. Wood furring, blocking, shims, and hanging strips for installing interior architectural woodwork items that are not concealed within other construction.

B. Related Requirements:
1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.
2. Section 064116 for wood finish on “Plastic-Laminate Faced Architectural Millwork”
3. Section 099100 “Painting” for field finishing of certain woodwork items

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:
1. Anchors.
2. Adhesives.
3. Shop finishing materials.

B. Shop Drawings:
1. Include the following:
   a. Dimensioned plans, elevations, and sections.
   b. Attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.

C. Samples: For each exposed product and for each shop-applied color and finish specified.

1. Size:
   a. Panel Products: 12 inches by 12 inches (300 mm by 300 mm).
   b. Lumber Products: Not less than 5 inches (125 mm) wide by 12 inches (300 mm) long for each species and cut, finished on one side and one edge.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For architectural woodwork manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical interior architectural woodwork as shown on Drawings including wall, base, trim, and chair rail
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Architectural Woodwork Standards, Section 2.

B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

1.8 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and Architectural Woodwork Standards.

2.2 INTERIOR TRIM AND PANELS FOR TRANSPARENT FINISH

A. Rift cut White Oak boards and veneer panels: Grade custom..

B. Finish to Match Armstrong World Industries Woodworks panels and trim. Finish Rift White Oak with transparent finish. https://www.armstrongceilings.com/commercial/en/articles/wood-grille-ceiling-wall-panels.html

2.3 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Custom.

1. Wood Species: Eastern white pine, sugar pine, or western white pine.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Nailers: Softwood Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

1. Fire-Retardant Treatment: Complying with requirements; provide where indicated.

B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.5 FABRICATION

A. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

a. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.
4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

C. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

D. Interior Architectural Woodwork for Opaque Finish: Shop prime with one coat of wood primer compatible with finish paint specified in Section 099100.

1. Back-priming: Apply one coat of primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

E. Transparent Finish:

1. Architectural Woodwork Standards Grade: Custom.
2. Finish System:
   a. 11: Polyurethane, Catalyzed.
3. Staining: To match Armstrong Rift White Oak.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. woodwork.

F. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.
1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.
3. For shop-finished items, use filler matching finish of items being installed.

G. Standing and Running Trim:
1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
2. Do not use pieces less than 36 inches (900 mm] long, except where shorter single-length pieces are necessary.
3. Scarf running joints and stagger in adjacent and related members.
4. Fill gaps, if any, between top of base and wall with plastic wood filler; sand smooth; and finish same as wood base if finished] [latex sealant, painted to match wall.
5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

END OF SECTION 064023

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SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL MILLWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced wall panels
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural panels that are not concealed within other construction.

B. Related Requirements:
1. Section 057500 ‘Decorative Formed Metal for face panels and metal base installed on millwork.
2. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
3. Section 064113 Wood Architectural Cabinets and Millwork
4. Section 123661.10 Solid Surface Countertops

1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1.5 ACTION SUBMITTALS

A. Product Data:
1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Product Data Submittals: For each product.

C. Shop Drawings:
   1. Include plans, elevations, sections, and attachment details.
   2. Show large scale details.
   3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
   5. Show attachment points of decorative metal panels.

D. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.

E. Samples for Initial Selection: For each type of exposed finish.

F. Samples for Verification: For the following:

   1. Plastic Laminates: 8 by 10 inches for each type, color, pattern, and surface finish required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of product including
   1. Composite wood products.
   2. High-pressure decorative laminate.
   3. Adhesives.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

A. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70percent during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL PANELS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of panels indicated for construction, finishes, installation, and other requirements.

B. Grade: Custom.

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Abet Laminati Inc.
b. Formica Corporation.
c. Lamin-Art, Inc.
d. Pionite; a Panolam Industries International, Inc. brand.
e. Or approved equal

D. Laminate Cladding for Exposed Surfaces:
1. Vertical Surfaces: Grade HGS.
2. Edges: Grade HGS

E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As selected by Architect from laminate manufacturer's full range in the following categories:
a. Solid colors, matte finish.
b. Patterns, matte finish.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
   1. Softwood Plywood: DOC PS 1.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets .

B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, [170] degrees of opening, self-closing.

C. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal.

E. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.

F. Shelf Rests: ANSI/BHMA A156.9, B04013; metal two-pin plastic with shelf hold-down clip.

G. Drawer Slides: ANSI/BHMA A156.9.
   1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
      a. Type: Full extension.
      b. Material: Galvanized steel ball bearing slides.
      c. Motion Feature: Self-closing mechanism.

H. Door Locks: ANSI/BHMA A156.11, E07121.

I. Drawer Locks: ANSI/BHMA A156.11, E07041.

J. Grommets for Cable Passage: 2-inch (51-mm)] OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
   1. Color: To be selected from manufacturers full range of colors.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA finish number indicated.
   1. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
   2. Satin Stainless Steel: ANSI/BHMA 630.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

B. Adhesive for Bonding Plastic Laminate: Contact cement.

2.5 FABRICATION

A. Fabricate architectural panels to dimensions, profiles, and details indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition panels to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips, No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION 064116

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mineral-wool blanket insulation.
   2. Mineral-wool board insulation.

B. Related Requirements:
   1. **Section 092900 "Gypsum Board"** for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Mineral-wool blanket insulation.
   2. Mineral-wool board insulation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Research Reports: For foam-plastic insulation, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation materials in original packaging with identification labels intact. Ensure that insulation materials are not exposed to moisture during delivery.

B. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

C. Protect mineral-wool insulation by storing materials off ground, away from harmful conditions, and at temperature conditions recommended by manufacturer. Store in original packaging.

PART 2 - PRODUCTS

A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

1. Basis-of-Design Product: Subject to compliance with requirements, provide ROCKWOOL (Roxul, Inc.); **COMFORTBATT**]or comparable product by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. Thermafiber, Inc.; an Owens Corning company.
    c. Or approved equal.

2. Flame-Spread Index: Not more than zero when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than zero when tested in accordance with ASTM E84.

2.2 MINERAL-WOOL BOARD INSULATION

A. Mineral-Wool Board Insulation, Unfaced : ASTM C612, Type IVA; passing ASTM E136 for combustion characteristics.

1. Basis-of-Design Product: Subject to compliance with requirements, provide ROCKWOOL (Roxul, Inc.); ROCKBOARD 40 or comparable product by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. Thermafiber, Inc.; an Owens Corning company.
    c. Or approved equal.

2. Nominal Density: 4 lb/cu. ft. (64 kg/cu. m).
3. Thermal Resistivity: 4.2 deg F x h x sq. ft./Btu x in. at 75 deg F (0.72 m² x K/W at 24 deg C).
4. Flame-Spread Index: Not more than zero when tested in accordance with ASTM E84.
5. Smoke-Developed Index: Not more than zero when tested in accordance with ASTM E84.

2.3 ACCESSORIES

A. Insulation for Miscellaneous Voids:
1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Demilec (USA) LLC.
        2) Or Approved Equal

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members in accordance with the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   1. Spray Polyurethane Insulation: Apply in accordance with manufacturer's written instructions.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

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SECTION 072713 - MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes self-adhering, vapor-retarding, modified bituminous sheet air barriers. Work includes:
   1. Air barrier on wood exterior members supporting roofing and wall systems.
   2. Where membrane air barrier is noted.

B. Related Work:
   1. Section 06100- Rough Carpentry
   2. Section 061600- Sheathing for application of air barrier over sheathing material.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; and tested physical and performance properties of products.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
   1. Protect substrates from environmental conditions that affect air-barrier performance.
   2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed liquid air barriers and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. when tested according to ASTM E2357.

C. Air Barrier shall have an air permeability not greater than 0.0004 cfm/ft² under pressure differential of 0.3 inch of water gage (75Pa) when tested in accordance with ASTM E2178.

2.3 SELF-ADHERING SHEET AIR BARRIER

A. Modified Bituminous Sheet: 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick, cross-laminated polyethylene film with release liner on adhesive side.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Carlisle Coatings & Waterproofing Inc. CCW-705
      b. Henry Company.
      c. Tremco Incorporated.
      d. Soprema
      e. Polyguard
      f. W.R. Meadows
      g. Or approved equal

   2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E2178.
b. Tensile Strength: Minimum 250 psi ; ASTM D412, Die C.
c. Ultimate Elongation: Minimum 200 percent; ASTM D412, Die C.
d. Puncture Resistance: Minimum 40 lbf ; ASTM E154/E154M.
e. Water Absorption: Maximum 0.15 percent weight gain after 48-hour immersion at 70 deg F (21 deg C); ASTM D570.
f. Vapor Permeance: Maximum 0.1 perm; ASTM E96/E96M, Desiccant Method.
g. Adhesion to Substrate: Minimum [16 lbf/sq. in. when tested according to ASTM D4541 as modified by ABAA.
h. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
i. UV Resistance: Can be exposed to sunlight for sixty (60) days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Stainless-Steel Sheet: ASTM A240/A240M, Type 304, 0.0187-inch-thick, and Series 300 stainless-steel fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

E. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

F. Bridge isolation joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 COORDINATION WITH SHEATHING

A. Coordinate installation of membrane air barrier on roof with installation of roof sheathing and composite nail-based roof insulation.

3.4 INSTALLATION

A. Install materials according to air-barrier manufacturer's written instructions and details and according to recommendations in ASTM D6135 to form a seal with adjacent construction and ensure continuity of air and water barrier.
   1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F (16 deg C).
   2. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

B. Prepare, treat, and seal inside and outside corners and vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D6135.

C. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.

D. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.
   1. Apply sheets in a shingled manner to shed water.
   2. Roll sheets firmly to enhance adhesion to substrate.

E. Apply continuous air-barrier sheets over accessory strips bridging substrate cracks, construction, and contraction joints.

F. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch- (150-mm-) wide, transition strip.

G. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counter flashings or ending in reglets with termination mastic.

H. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
   1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
   2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.

I. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.

J. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

K. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier material with foam sealant.

L. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fish mouths and blisters. Patch with air-barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.

M. Do not cover air barrier until it has been tested and inspected by testing agency.

N. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
   1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-

barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.

2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 072713

SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing materials.
3. Vapor retarder.
4. Roof insulation.
5. Insulation accessories and cover board.
6. Asphalt materials.
7. Walkways.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
3. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counter lashings and formed roof edge assemblies.
4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Owner’s Project Manager, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.

6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan indicating orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

C. Samples for Verification: For the following products:
1. Roof membrane and flashings, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer

B. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Evaluation Reports: For components of roofing system, from ICC-ES.

D. Field Test Reports:
1. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, vapor retarder, and other components of roofing system.
2. Warranty Period: twenty (20) years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of

roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway product], for the following warranty period:

1. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings to remain watertight.

B. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Roofing System Design: Roofing System shall be designed to withstand loads indicated on Drawings, but not less than required by Code.
1. Rhode Island State Building Code 2021, ASCE 7.

D. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

E. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING SYSTEM

A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, fabric-backed at curved roof and self-adhering TPO sheet all other locations.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elevate, Holcim Building Envelope; UltraPly TPO and TPO Flex SA with Secure Bond Technology Membrane or comparable product by one of the following:
   a. GenFlex Roofing Systems.
   b. Mule-Hide Products Co., Inc.
   c. Or approved equal

2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.
3. Thickness: 60 mils , nominal.
4. Exposed Face Color: Gray.
5. Integrated Adhesive: Factory-applied at20 deg F (7 deg C)

2.3 ACCESSORY ROOFING MATERIALS

A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
   1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

      a. Basis-of-Design Product: Subject to compliance with requirements, provide Elevate, Holcim Building Envelope; Ultraply Bonding Adhesive or comparable product.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing 60 mils thick, minimum, of same color as TPO sheet.

   1. Basis-of-Design Product: Subject to compliance with requirements, provide Elevate, Holcim Building Envelope; UltraPly TPO QuickSeam Flashing or comparable product.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

   1. Basis-of-Design Product: Subject to compliance with requirements, provide Elevate, Holcim Building Envelope; UltraPly TPO QuickSeam Pipe Flashing, UltraPly TPO Reinforced Split Pipe Boots UltraPly TPO Universal Pipe Boot, or comparable product.

D. Roof Vents: As recommended by roof membrane manufacturer.

   1. Size: Not less than 4-inch (100-mm) diameter.

E. Edge Sealant: Polymer-based sealant used to seal all cut membrane edges where the polyester reinforcement is exposed.

   1. Basis-of-Design Product: Subject to compliance with requirements, provide Elevate, Holcim Building Envelope; UltraPly TPO Cut Edge Sealant LVOC or comparable product.

F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Elevate, Holcim Building Envelope; Termination Bar or comparable product.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

   1. Basis-of-Design Product: Subject to compliance with requirements, provide Elevate, Holcim Building Envelope; All-Purpose Fastener or comparable product.

H. Miscellaneous Accessories: Provide preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

I. Primer: Solvent-based primer, used to improve adhesion of liquid or sheet vapor barriers to nonporous substrates.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elevate, Holcim Building Envelope; Single-Ply QuickPrime LVOC Primer or comparable product.

2.4 VAPOR RETARDER

A. Polyethylene Film: ASTM D4397, 10 mils thick, minimum, with maximum permeance rating of 0.076 perm.
1. Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.
2. Adhesive: Manufacturer's standard lap adhesive, listed by FM Approvals for vapor retarder application.

2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roof membrane manufacturer.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 2, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elevate, Holcim Building Envelope; ISOGARD CG Insulation or comparable product by one of the following:
   a. Atlas Roofing Corporation - Polyiso.
   b. Carlisle SynTec Incorporated.
   c. Or approved equal

2. Compressive Strength: 20 psi.
3. Size: 48 by 96 inches.
4. Thickness: In layers to achieve thickness on drawings

C. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6.35 mm).
3. Slope:

   a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
   b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES AND COVER BOARD

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation[and cover boards] to substrate, and acceptable to roofing system manufacturer.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elevate, Holcim Building Envelope; All-Purpose Fastener or comparable product.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elevate, Holcim Building Envelope; I.S.O. Twin Pack Adhesive or I.S.O. Spray R Adhesive or comparable product.
2. Bead-applied, low-rise, one-component, or multicomponent urethane adhesive.
3. acetaldehyde to not exceed 9 mcg/cu. m.

D. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Certainteed; SAINT-GOBAIN.
b. Georgia-Pacific Gypsum LLC.
c. National Gypsum Company.
d. USG Corporation.

2. Thickness: 5/8 inch.
3. Surface Finish: Unprimed

2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elevate, Holcim Building Envelope; QuickSeam Walkway Pad or comparable product by one of the following:
2. Size: 30 inches (762 mm) wide by approximately 30 ft. (9.1 m) long; see Drawings.
3. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that concrete substrate is visibly dry and free of moisture.
4. (3.2 mm) at top surface.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation in accordance with roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Perform fastener-pullout tests in accordance with roof system manufacturer's written instructions.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system in accordance with roofing system manufacturer's written instructions.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.
1. Loosely lay substrate board over roof deck.

3.4 INSTALLATION OF VAPOR RETARDER

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 and 6 inches (50 and 150 mm), respectively.

1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
2. Continuously seal side and end laps with tape or adhesive.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.5 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Wood and Wood Panel Decking:

1. Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood decks.

2. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows, end joints staggered not less than 12 inches (305 mm) in adjacent rows.
   a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
   c. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
   d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
   e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
   f. Loosely lay base layer of insulation units over substrate.

3. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood decks.
   a. Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

4. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
   a. Retain first subparagraph below and delete last subparagraph above for 48-by-96-inch (1219-by-2438-mm) insulation boards.
   b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
   c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
   e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
      1) Trim insulation so that water flow is unrestricted.
   f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
   g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
   h. Loosely lay each layer of insulation units over substrate.
   i. Adhere each layer of insulation to substrate using adhesive in accordance with SPRI's Directory of Roof Assemblies listed roof assembly requirements for

specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

D. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered) in adjacent rows end joints staggered not less than 12 inches (305 mm) in adjacent rows.
   a. When installing composite and non-composite insulation in two or more layers, install non composite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
   b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
   d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
      1) Trim insulation so that water flow is unrestricted.
   e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
   f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
   g. Adhere base layer of insulation to vapor retarder in accordance with Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
      1) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
   a. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
   b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
   d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
   e. Trim insulation so that water flow is unrestricted.
   f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
   g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
   h. Adhere each layer of insulation to substrate using adhesive in accordance with SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
      1) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
      2) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.
   1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   2. At internal roof drains, conform to slope of drain sump.
      a. Trim cover board so that water flow is unrestricted.
      b. Cut and fit cover board tight to nailers, projections, and penetrations.
   3. Adhere cover board to substrate using adhesive in accordance with [FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification] [SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity] and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
      a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
      b. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Place plates on insulation in required fastening patterns and secure in accordance with manufacturer’s instructions.

   1. Install plates and fasteners tight and flat to substrate with no dimpling, and with fastener extending 1 inch (25 mm) minimum into roof deck; do not overdrive fasteners.

3.7 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing in accordance with roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

D. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer and install fabric-backed roof membrane.

G. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

H. Apply roof membrane with side laps shingled with slope of roof deck where possible.

I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.

J. Spread sealant bed over deck-drain flange at roof drains and securely seal roof membrane in place with clamping ring.

3.8 INSTALLATION OF SELF-ADHERING ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing in accordance with roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

D. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer.

E. Substrates to be clean, dry, and free of foreign material that inhibits adhesion.

F. Install TPO membrane with integrated adhesive only when ambient and substrate temperatures are plus 20 deg F (minus 7 deg C) minimum and rising.

G. Lay out membrane pieces to install field and flashing splices to shed water. Install without wrinkles, without gaps, or fish mouths in seams, bond and test seams and laps in accordance with membrane manufacturer's written instructions and details.

H. Beginning at low point of roof, place membrane without stretching over substrate and allow to relax at least 30 minutes before attachment or splicing; in colder weather allow for longer relax time.

I. Fold membrane back from parapet wall onto itself exposing back side of TPO membrane and the release liner.

J. Mark release liner where front of pretaped edge of reinforced perimeter strip and membrane meet.

K. Chalk line across release liner. Using safety envelope opener or other approved cutting tool, cut release liner along chalk line. Using a utility knife is unacceptable.

L. Begin installation by pulling TPO membrane back onto itself approximately 10 ft. (3.05 m).

M. Remove release liner at 45-degree angles on both sides of TPO membrane.

N. Roll TPO membrane back to front edge of reinforced perimeter strip.

O. Allow loose sections of release liner to follow TPO membrane as membrane is rolled in place, keeping release liner flat and sticking out perpendicular to TPO membrane seams. TPO membrane to adhere to insulation substrate as it is rolled back in place.

P. Starting at one end, pull release liner on either side of sheet at 45-degree angle pulling evenly on both sides in one continuous motion), keeping the release liner close to the roof deck.

Q. As the two release liners are simultaneously removed, a third installer is to walk down center of membrane just behind release liner being removed for entire length of run to keep sheet from moving.

R. Using a push broom, immediately sweep membrane across narrow width of sheet to promote adhesion to substrate and assist adhesion of membrane to insulation board.

S. Roll installed membrane with weighted roller weighing a minimum of 5 lbf-in. (0.56 Nm) perpendicular to long seams of membrane to ensure full contact adhesion of membrane to substrate. Use of weighted roller when installing TPO membrane to rigid insulation or coverboard is unacceptable.

T. Repeat preceding installation steps, as necessary.

U. Follow current manufacturer written instructions and technical specifications for heat welding TPO membrane.
   1. Stagger end laps.

V. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

W. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.

X. Spread sealant bed over deck-drain flange at roof drains and securely seal roof membrane in place with clamping ring.

3.9 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories and adhere to substrates in accordance with roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.10 INSTALLATION OF WALKWAYS

A. Flexible Walkways:
   1. Install flexible walkways at the following locations:
      a. Perimeter of each rooftop unit.
      b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
      c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
      d. Top and bottom of each roof access ladder.
      e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
      f. Locations indicated on Drawings.
      g. As required by roof membrane manufacturer's warranty requirements.
   2. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive in accordance with roofing system manufacturer's written instructions.

3.11 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.12 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and in accordance with warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075423

SECTION 076100 - SHEET METAL ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Custom-fabricated, standing-seam sheet metal roofing.

B. Related Requirements:
1. Section 076200 "Sheet Metal Flashing and Trim" for gutters and downspouts and flashings that are not part of sheet metal roofing.
2. Section 079200 "Joint Sealants" for field-applied sealants adjoining sheet metal roofing and not otherwise specified in this Section.

1.3 COORDINATION

A. Coordinate sheet metal roofing layout and seams with sizes and locations of roof curbs, equipment supports, equipment provided, and roof penetrations.

B. Coordinate sheet metal roofing installation with rain drainage work, flashing, trim, and construction of roofing substrate, parapets, walls, and other adjoining work to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review structural loading limitations of substrates during and after roofing installation.
3. Review insulation, air barrier, vapor retarder, and underlayment requirements.
4. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affect sheet metal roofing.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Roofing sheet metal.

2. Underlayment materials.
3. Fasteners.
4. Sealant tape.
5. Elastomeric sealant.

B. Shop Drawings:
1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and panel installation layouts, expansion joint locations, points of fixity, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include details for forming, including seams and dimensions.
4. Include details for joining and securing, including layout, and spacing of fasteners, cleats, and other attachments. Include pattern of seams.
5. Include details of expansion joints, including showing direction of expansion and contraction from points of fixity.
6. Include details of roof penetrations.
7. Include details of edge conditions, including eaves, ridges rakes, crickets, flashings, and counterflashings.
8. Include details of special conditions.
9. Include details of connections to adjoining work.,

C. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long by actual width.

D. Samples for Initial Selection: For each type of sheet metal with factory-applied finishes.

1. Include Samples of trim and accessories involving finish or color selection.

E. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Roofing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, [battens,]and other attachments.
2. Trim and Metal Closures: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Other Accessories: 12-inch- (300-mm-) long Samples for each type of other accessory.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, on which the following items are indicated and coordinated with each other, using input from installers of the items involved:
1. Snow guards.
2. Details for penetrations.

B. Qualification Data: For Installer and fabricator.

1. Include listing of completed projects of comparable scale of this Project, including name, address, telephone, and contact person for Architect, and name, address, telephone number, and contact person for building Owner.

C. Evaluation Reports: For self-adhering, high-temperature sheet underlayment, from ICC-ES.

D. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing sheet metals and accessories to include in maintenance manuals.

B. Special warranties.

1.8 QUALITY ASSURANCE

A. Sheet Metal Roofing Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal roofing similar to that required for this Project and whose products have a record of successful in-service performance.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal roofing materials in contact with other materials that might cause staining, denting, or other surface damage.
   1. Protect stored sheet metal roofing materials from contact with water.

B. Protect strippable protective covering on sheet metal roofing from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal roofing installation.

1.10 WARRANTY

A. Special Warranty: Warranty form at end of this Section in which Installer agrees to repair or replace components of sheet metal roofing that fail in materials or workmanship within specified warranty period.
   a. Failures include, but are not limited to, the following:
   b. Structural failures, including, but not limited to, rupturing, cracking, or puncturing.
   c. Wrinkling or buckling.
   d. Loose parts.
   e. Failure to remain weathertight, including uncontrolled water leakage.
   f. Galvanic action between sheet metal roofing and dissimilar materials.
   2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal roofing that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Sheet metal roofing system, including, but not limited to, metal roof panels, cleats, anchors and fasteners, sheet metal flashing integral with sheet metal roofing, fascia panels, trim, underlayment, and accessories, shall comply with requirements without failure due to defective manufacture, fabrication, or installation, or due to other defects in construction. Sheet metal roofing shall remain watertight.

B. Sheet Metal Roofing Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.
1. Temperature Change: 120 deg F (67 deg C), ambient..

D. Air Infiltration: Air leakage of not more than 0.009 cfm/sq. ft. (0.024 L/s per sq. m) when tested in accordance with ASTM E283 at the following test-pressure difference:
1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa)

E. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:
1. Thinseam: 6.24 psf (300 Pa).
2. Test-Pressure Difference: 15 lbf/sq. ft. (718 Pa).

2.2 ROOFING SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 (Z275) coating designation with smooth, flat surface; prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Fabral; Thin Seam or comparable product by one of the following:
   a. Amerimax (aka Atlanta Metal Products, Inc.); an OmniMax company.
   b. MBCI.
   c. PAC-CLAD; Petersen Aluminum Corporation.
   d. Or approved equal

2. Thickness: Nominal 0.034 inch (0.86 mm), 22 gauge.
3. Exposed Coil-Coated Finish:

   a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat.

Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

4. Color: As selected by Architect from manufacturer's full range.
5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with written instructions of underlayment manufacturer.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Fabral; All Purpose High-Temperature Underlayment or comparable product by one of the following:
      a. Atlas EPS; a division of Atlas Roofing Corporation.
      b. Or approved equal
   2. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F (116 deg C) or higher.
   3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C) or lower.

B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete roofing system and as recommended by primary sheet metal manufacturer unless otherwise indicated.

B. Fasteners: Wood screws, annular-threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
   1. General:
      a. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed; with hex-washer head.
      b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.

   2. Fasteners for Zinc-Coated (Galvanized)Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal roofing and remain watertight.

E. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187.
   1. acetaldehyde shall not exceed 9 mcg/cu. m.

2.5 ACCESSORIES

A. Sheet Metal Accessories: Provide components required for complete sheet metal roofing assembly, including trim, fasciae, corner units, clips, flashings, sealants, gaskets, fillers, metal closures, closure strips, and similar items. Match material and finish of sheet metal roofing unless otherwise indicated.
   1. Cleats: Intermittent and continuous attachment devices for mechanically seaming into joints and formed from the following materials and thicknesses unless otherwise indicated:
      a. Metallic-Coated Steel Roofing: 0.0250-inch minimum thick stainless steel.
   2. Expansion-Type Cleats: Cleats of a design that allows longitudinal movement of roof panels without stressing panel seams; of same material as other cleats.
   3. Backing Plates: Plates at roofing splices, fabricated from material recommended by SMACNA's "Architectural Sheet Metal Manual."
   4. Flashing and Trim: Formed from same material and with same finish as sheet metal roofing, minimum 0.018 inch thick.

2.6 FABRICATION

A. Custom fabricate sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions (panel width and seam height), geometry, metal thickness, and other characteristics of installation. Fabricate sheet metal roofing and accessories in shop to greatest extent possible.
   1. Standing-Seam Roofing: Form standing-seam panels with finished seam height of 1 ¾ inches.

B. Fabrication Tolerances: Fabricate sheet metal roofing that is capable of installation to a tolerance of 1/4 inch in 20 ft. (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Form exposed sheet metal work to fit substrates with little oil canning; free of buckling and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
   1. Lay out sheet metal roofing, so transverse seams, if required, are made in direction of flow, with higher panels overlapping lower panels.
   2. Fold and cleat eaves and transverse seams in shop.
   3. Form and fabricate sheets, seams, strips, cleats, valleys, edge treatments, integral flashings, and other components of metal roofing to profiles, patterns, and drainage arrangements indicated on Drawings and as required for leakproof construction.

D. Expansion Provisions: Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

E. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant in accordance with SMACNA's "Architectural Sheet Metal Manual."

F. Sheet Metal Accessories: Custom fabricate flashings and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item required. Obtain field measurements for accurate fit before shop fabrication.
1. Form exposed sheet metal accessories without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
2. use.[Rivet joints where necessary for strength.]
3. Sealed Joints: Form no expansion, but movable, joints in metal to accommodate elastomeric sealant.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices of sizes recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.

G. Do not use graphite pencils to mark metal surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking, that tops of fasteners are flush with surface, and that installation is within flatness tolerances required for finished roofing installation.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored, and that provision has been made for drainage, flashings, and penetrations through sheet metal roofing.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating sheet metal roofing to verify actual locations of penetrations relative to seam locations of sheet metal roofing before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Lay out panel arrangement before installation of sheet metal roofing.

1. Space fasteners not more than 16 inches o.c.

3.3 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering High-Temperature Sheet Underlayment:
1. Install self-adhering high-temperature sheet underlayment, wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses.
5. Overlap side edges not less than 3-1/2 inches (90 mm).
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days of installation.
8. Install self-adhering high-temperature underlayment at the following locations:
   a. Over entire roof.

B. Install slip sheet, wrinkle free, over underlayment before installing sheet metal roofing and related flashing.
1. Install in shingle fashion to shed water, with lapped joints of not less than 4 inches (100 mm).

3.4 INSTALLATION, GENERAL

A. Install sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for complete roofing system.
2. Install sheet metal roofing true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal roofing and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Do not field cut sheet metal roofing by torch.
5. Provide metal closures at rake edges and rake walls.
6. Flash and seal sheet metal roofing with closure strips at eaves, rakes, and perimeter of all openings. Fasten with self-tapping screws.
7. Locate and space fastenings in uniform vertical and horizontal alignment. Predrill panels for fasteners.
8. Lap metal flashing over sheet metal roofing to direct moisture to run over and off roofing.
9. Do not use graphite pencils to mark metal surfaces.

B. Thermal Movement: Rigidly fasten metal roof panels to structure at only one location for each panel.

1. Allow remainder of panel to move freely for thermal expansion and contraction.
2. Point of Fixity: Fasten each panel along a single common line of fixing located at eave

C. Fasteners: Use fastener sizes that penetrate substrate, not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

D. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating, by applying self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended in SMACNA's "Architectural Sheet Metal Manual."

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Fasciae:
1. Align bottom of sheet metal roofing and fasten with blind rivets, bolts, or self-tapping screws.
2. Flash and seal sheet metal roofing with closure strips where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.5 INSTALLATION OF CUSTOM-FABRICATED SHEET METAL ROOFING

A. Standing-Seam Roofing:

1. Attach standing-seam metal panels to substrate with double-fastened cleats spaced at 12 inches o.c.
2. Install panels reaching from eave to ridge before moving to adjacent panels.
3. Before panels are interlocked, apply continuous bead of sealant to top of flange of lower panel.
4. Lock standing seams by folding over twice, so cleat and panel edges are completely engaged.
   a. Attach edge flashing to face of roof edge with continuous cleat fastened to roof substrate at 12-inch o.c. spacing.
   b. Lock panels to edge flashing.
5. Leave seams upright after locking at ridges and hips.

3.6 INSTALLATION OF ACCESSORIES

A. Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion.
1. Coordinate installation with flashings and other components.
2. Install components required for complete sheet metal roofing assembly, including trim, seam covers, flashings, metal closures, and similar items.

3.7 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal roofing within installed tolerance of 1/4 inch in 20 ft. (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. On completion of sheet metal roofing installation, clean finished surfaces as recommended by sheet metal roofing manufacturer.

C. Clean and neutralize flux materials. Clean off excess solder.

D. Clean off excess sealants.

3.9 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal roofing is installed unless otherwise indicated in manufacturer's written installation instructions.

B. Prohibit traffic of any kind on installed sheet metal roofing.

C. Maintain sheet metal roofing in clean condition during construction.

D. Replace sheet metal roofing components that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076100

SECTION 076200 - SHEET METAL FLASHING AND TRIM *(PART OF FILED SUB-BID SECTION 070002)*

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Formed roof-drainage sheet metal fabrications, gutters, and downspouts.
   2. Formed low-slope roof sheet metal fabrications.
   3. Formed wall sheet metal fabrications.
   4. Through wall metal flashing where indicated.

B. Related Requirements:
   1. Section 042000- Unit Masonry for locations of through wall metal flashings
   2. Section 061000 "Rough Carpentry for wood nailers, curbs, and blocking.
   3. Section 075423 “Thermoplastic-Polyolefin (TPO) Roofing for membrane flashing integral with TPO roofing
   4. Section 076100 Sheet Metal Roofing for coordination with sheet metal assemblies.

1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review construction schedule.
   2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following
   1. Elastomeric sealant.

B. Shop Drawings: For sheet metal flashing and trim.
   1. Include plans, elevations, sections, and attachment details.
   2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.

3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout, and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of edge conditions.
8. Include details of special conditions.
9. Include details of connections to adjoining work.
10. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches .

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.7 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to

weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
   1. Exposed Coil-Coated Finish:
      a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions
   2. Color: Color will be selected by Architect from manufacturer’s full range standard solid colors. No metallic finishes.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304 dead soft, fully annealed; with [smooth, flat surface.
   1. Finish: ASTM A480/A480M, No. 4 (polished directional satin).
      a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
      b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
         1) Run grain of directional finishes with long dimension of each piece.
         2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Self-tapping screws, self-locking rivets and bolts, and other suitable fasteners

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

    a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

C. Elastomeric Sealant: ASTM C920, elastomeric polyurethane] [polysulfide] [silicone] polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

D. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

E. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

F. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

G. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:
1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, non-expansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams:
1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

H. Do not use graphite pencils to mark metal surfaces.

2.5 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch- (2400-mm-) long sections.
3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
4. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
5. Gutter Profile: Style A in accordance with cited sheet metal standard.
6. Expansion Joints: Lap type.
7. Fabricate from the following materials:
   a. Aluminum: 0.040 inch

B. Downspouts: Fabricate round downspouts to dimensions indicated on Drawings, complete with mitered elbows. SMACNA figure 1-32A Furnish with metal hangers from same material as downspouts and anchors; Shop fabricate elbows.

1. Fabricated Hanger Style: Fig. 1-35J in accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Fabricate from the following materials:
   a. Aluminum: 0.024 inch thick.

2.6 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
   1. Stainless Steel: 0.016 inch thick.

B. Formed Metal Wall Flashings:
   1. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
      a. Exposed Coil-Coated Finish:
         1) Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      b. Color: Color will be selected by Architect from manufacturer’s full range standard solid colors. No metallic finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

   1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.

3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
6. Space individual cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet with no joints within 24 inches (600 mm) of corner or intersection.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.

G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.3 INSTALLATION OF ROOF-DRAINAGE SYSTEM

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:
1. Join sections with joints sealed with sealant.
2. Provide for thermal expansion.

3. Attach gutters at eave or fascia to firmly anchor them in position.
4. Provide end closures and seal watertight with sealant.
5. Slope to downspouts.
6. Fasten gutter spacers to front and back of gutter.
7. Anchor gutter with straps 24 inches apart to roof deck unless otherwise indicated and loosely lock to front gutter bead.
8. Install gutter with expansion joints not exceeding 50 feet apart. Install expansion-joint caps.

C. Downspouts:
1. Join sections with 1-1/2-inch (38-mm) telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
4. Provide elbows at base of downspout to direct water into cast iron downspout boot
5. Connect downspouts to underground drainage system.

3.4 INSTALLATION OF WALL FLASHINGS

A. Through Wall Flashing: Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated.

B. Formed Wall Flashing: Furnish formed wall flashing to be installed by others at head condition of wall-opening components such as windows, doors, louvers, and horizontal transitions between materials.
1. Sill flashing at openings is furnished and installed by Section 076200.

3.5 INSTALLATION OF WALL SHEET METAL FABRICATIONS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.6 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

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SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Roof hatches.

B. Related Requirements:

   1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.

1.2 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.

   1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.5 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: twenty [20] [10] years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 ROOF HATCHES

A. Roof Hatches: Metal roof-hatch units with lids and insulated [single] [double]-walled curbs, welded corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing,[straight sides,] [integral metal cant,] [stepped integral metal cant raised the thickness of roof insulation,] and integrally formed deck-mounting flange at perimeter bottom.

B. Basis-of-Design Product: Subject to compliance with requirements, provide BILCO Company Type E-50-TB or comparable product by one of the following:

1. Acudor Products, Inc.
2. Babcock Davis
3. JL Industries, Inc.
4. Pate Company (The).
5. Or approved equal.

C. Type and Size: Single-leaf 36 by 36 inches

D. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa internal uplift load.

E.

F. Hatch Material: Aluminum-zinc alloy-coated steel sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated.
2. Finish: Two-coat fluoropolymer
3. Color: Gray

G. Hatch Material: Aluminum sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated.
2. Finish: Two-coat fluoropolymer.
3. Color: As selected by Architect from manufacturer's full range.

H. Construction:

1. Insulation: 3-inch- (75-mm-) thick, polyisocyanurate board.
   a. R-Value: 20.3 in accordance with ASTM C1363.

2. Gasket: Full EPDM rubber gasket around the perimeter of the cover.
3. Hatch Lid: Insulated and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
5. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.

I. Hardware: Spring operators, hold-open arm, steel slam latch with turn handles and padlock hasps inside and outside.
1. Provide lift assistance and automatic hold-open arm.

J. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, self-closing and latching gate at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches above finished roof deck.
2. Posts and Rails: Schedule 40 pipe in 6061 T6 aluminum, 1-1/4 inches (31 mm) in diameter.
3. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm) in diameter.
4. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
5. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
6. Fabricate joints exposed to weather to be watertight.
7. Fasteners: Type 316 stainless steel.
8. Finish: Powder-coat paint finish.
   a. Color: High-visibility safety yellow.

K. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position. Lift assistance provided for ease of operation.
2. Height: 42 inches (1060 mm) above finished roof deck.

3. Material: Steel tube.
4. Post: 1-1/2-inch- (38-mm-) square tubing.
5. Finish: Manufacturer's standard powder coat in safety yellow.

2.3 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel in accordance with ASTM A153/A153M or ASTM F2329.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

C. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install roof accessories in accordance with manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

C. Roof-Hatch Installation:

1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
2. Attach safety railing system to roof-hatch curb.
3. Attach ladder-assist post in accordance with manufacturer's written instructions.

D. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Clean exposed surfaces in accordance with manufacturer's written instructions.

B. Clean off excess sealants.

C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

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SECTION 077253 - SNOW GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rail-type, seam-mounted snow guards.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   1. Rail-type, seam-mounted snow guards.

B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.
   1. Include details of rail-type snow guards.

C. Samples:

   1. Rail-Type Snow Guards: Bracket, 12-inch- (300-mm-) long rail, and installation hardware.

1.3 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit adhesive-mounted snow guards to be installed, and adhesive cured, according to adhesive manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer or factory technical designer, to design snow guards, including attachment to roofing material, as applicable for attachment method, based on the following:
   1. Roof snow load.
   2. Snow drifting
   3. Roof slope.
   4. Roof type.
   5. Roof dimensions.
   6. Snow guard type.
   7. Snow guard fastening method and strength.
   8. Snow guard spacing.

B. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: 120 deg F ambient.

C. Structural Performance: Snow guards to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Snow Loads:
a. Minimum Flat Roof Snow Load: 30 psf
b. Ground Snow Load: 30psf

2.2 RAIL-TYPE SNOW GUARDS

A. Rail-Type, Flat-Mounted Snow Guards: Basis of Design Manufacturer Alpine Snow Guards. https://www.alpinesnowguards.com/.
1. Description: Units fabricated from metal fixed bracket and equipped with two pipes. .
2. Brackets: ASTM B209 (ASTM B209M) aluminum; clear anodized finish.
3. Bars: ASTM B221 (ASTM B221M) aluminum; clear anodized
a. Profile: Round

4. Seam Clamps: ASTM B221 (ASTM B221M) aluminum extrusion or ASTM B85/B85M aluminum casting with stainless steel set screws incorporating round nonpenetrating point; designed for use with applicable roofing system to which clamp is attached.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare substrates for bonding snow guards.

B. Prime substrates according to snow guard manufacturer's written instructions.

3.3 INSTALLATION

A. Install snow guards according to manufacturer's written instructions.
1. Space rows as recommended by manufacturer and shown on Shop Drawings.

B. Attachment for Standing-Seam Metal Roofing:

1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.

2. Rail-Type, Seam-Mounted Snow Guards:
   a. Install brackets to vertical ribs in straight rows.
   b. Secure with stainless steel set screws, incorporating round nonpenetrating point, on same side of standing seam.
   c. Torque set screw in accordance with manufacturer's written instructions.
   d. Install cross members to brackets.

END OF SECTION 077253

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SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Penetration firestopping systems.
   1. Penetration firestopping systems in fire-resistance-rated walls.
   2. Penetration firestopping systems in horizontal assemblies.
   3. Penetration firestopping systems in smoke barriers.
   4. Exposed penetration firestopping systems.

B. Related Requirements:
   1. Section 079200 "Joint Sealants" for non-fire-resistance-rated joint sealants.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Sie.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

A. Unlisted Firestopping Systems: Obtain an Engineering Judgment (EJ) from firestopping manufacturer where no UL, FM Approvals, or other listed assembly is available for particular firestop configuration. Follow International Firestop Council (IFC) recommended guidelines for evaluating firestopping systems in EJs.

   1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) recommended guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Listed System Designs: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Entity that has been approved by FM Approvals in accordance with FM Approvals 4991 or been evaluated by UL Solutions and found to comply with "UL Solutions Qualified Firestop Contractor Program."

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of each penetration firestopping system type required for Project, including supporting construction substrates, attachments, and accessories.
2. combination.
3. Obtain approval of mockups from authorities having jurisdiction before proceeding.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping systems when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping system materials in accordance with manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be accessed and installed in accordance with specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain penetration firestopping systems for each type of opening indicated from single manufacturer.

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration firestopping systems must be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Penetration firestopping systems must be installed with products bearing the classification marking of a qualified testing agency.

a. UL Solutions in its online directory "Product iQ."
b. Intertek Group in its "Directory of Building Products."
c. FM Approvals in its "Approval Guide."

2. Provide components for each penetration firestopping system that, upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristic during and after construction.
3. Provide components for each penetration firestopping system that do not contain ethylene glycol.
4. Provide components for each penetration firestopping system that are sufficiently flexible to accommodate movement, such as pipe vibration, water hammer, thermal expansion, and other normal building movement without damage.
5. Provide components for each penetration firestopping system that are appropriately tested for the thickness and type of insulation utilized.

B. Provide penetration firestopping systems that resist spread of fire, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Specified Technologies Inc.; **EZ-Path Series**, **FyreFlange HVAC Firestop Angle**, **SpecSeal Intumescent Firestop Block**. **SpecSeal Intumescent Firestop Plug**, **SpecSeal LC Endothermic Firestop Sealant** or comparable product by one of the following:

a. Hilti, Inc.
b. RectorSeal.
c. Or approved equal

C. Penetration Firestopping Systems in Fire-Resistance-Rated Walls: Systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: Not less than the fire-resistance rating of the wall assembly penetrated.
2. Membrane Penetrations: Install recessed fixtures such that the required fire resistance will not be reduced.

D. Penetration Firestopping Systems in Horizontal Assemblies: Systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor/ceiling assembly penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of the floor/ceiling assembly.

E. Penetration Firestopping Systems in Smoke Barriers: Systems with ratings determined in accordance with UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

F. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84 or UL 723.

G. Provide products that, upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture.

H. When intumescent products are used, provide products that do not contain sodium silicate or any other water-soluble intumescent ingredient in the formulation.

I. Provide products that do not contain ethylene glycol.

J. Provide firestop sealants sufficiently flexible to accommodate movement such as pipe vibration, water hammer, thermal expansion, and normal building movement without damage to the seal.

K. Pipe insulation will not be removed, cut away, or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the type and thickness of insulation utilized.

L. Dissimilar Materials: Noncombustible penetrating items will not connect to combustible items beyond the point of firestopping unless it can be demonstrated that the fire-resistance integrity of the wall is maintained.

M. Cable Pathway Devices: For penetrations of data, video, and communications cables in locations where frequent cable moves, add-ons, and changes will occur, provide fire-rated pathway devices with a built-in fire-sealing system sufficient to maintain the hourly fire rating of the barrier penetrated and automatically adjust to the installed cable loading and permit cables to be installed, removed, or retrofitted without the need to remove or reinstall any firestop materials. Such devices will be:

1. Capable of retrofit around existing cables;
2. Designed such that two or more devices can be ganged together;
3. Maintenance-free such that no action is required to activate the smoke- and fire-sealing mechanism.

N. When cable pathway devices are not practical, data, video, and communications cabling penetrations to be firestopped with re-enterable products specifically designed for retrofit.

O. Fire-Rated Cable Sleeve Kits: When used, provide complete kits designed for new or existing cable penetrations through walls, which include a precut metallic sleeve, end caps to prevent sharp edges, mounting escutcheons, intumescent escutcheon gaskets, firestop putty, and wall warning labels, and are sized to same O.D. as standard EMT (Electrical Mechanical Tubing) to accept standard accessories.

P. Thermal Wrap: For fire protection of membrane penetrations of utility boxes, critical electrical circuits, and exposed fuel lines, provide a flexible protective wrap that, when exposed to fire, releases chemically bound water to have a cooling effect (endothermic), and is tested and listed for up to 2-hour fire ratings in accordance with ASTM E814 or UL 1479 for membrane penetrations or ASTM E1725 or UL 1724 for thermal barrier and circuit.

2.3 ACCESSORIES

A. Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated, including but not limited to:

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.4 FILL MATERIALS

A. If fill materials are Contractor's choice, retain only those paragraphs below that suit Project.

1. Technologies Inc.; SpecSeal CID Cast-In Firestop Devices.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Specified Technologies Inc.; **BlazeStop WF300 Intumescent Firestop** or **SpecSeal LC Endothermic** Sealant.

C. Firestopping Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

E. Intumescent Wrap Strips: Single-component intumescent elastomeric strips for use around combustible penetrants.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Specified Technologies Inc.; SSW Intumescent Wrap Strips.

F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Specified Technologies Inc.; SpecSeal SSP Firestop Mortar.

G. Pillows/Bags: Compressible, removable, and reusable intumescent pillows encased in fire-retardant polyester or glass-fiber cloth. Where exposed, and when required by a listed system, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed or dislodged.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Specified Technologies Inc.; SpecSeal SSB Intumescent Firestop Pillows.

H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Specified Technologies Inc.; SpecSeal SIL300 Silicone Sealant.

J. Thermal and Endothermic Wraps: Flexible, insulating, and fire-resistant protective wraps tested and listed for up to 2-hour fire ratings in accordance with ASTM E814 or UL 1479; for protecting membrane penetrations of utility boxes, critical electrical circuits, communications lines, and fuel lines, and for thermal barrier and circuit integrity protection in accordance with ASTM E1725 or UL 1724.

K. Fire-Rated Cable Sleeve Kits: Complete kits designed for new or existing cable penetrations through walls which accept standard accessories.

L. Fire-Rated Cable Pathways: Single or gangable device modules composed of a steel raceway with integral intumescent material and requiring no additional action in the form of plugs, twisting closure, putty, pillows, sealant, or otherwise to achieve fire and air-leakage ratings.

1. Fire-rated cable pathway devices are the preferred product for data, video, and communications cable penetrations. Install these devices in locations where frequent cable moves, add-ons, and changes will occur. Such devices must be:

a. Capable of retrofit around existing cables.
b. Designed so that two or more devices can be ganged together.
c. Maintenance-free so no action is required to activate the smoke- and fire-sealing mechanism.

2. Where fire-rated cable pathway devices are not practical, openings within walls and floors designed to accommodate data, video, and communications cabling must be provided with re-enterable products specifically designed for retrofit, such as retrofit devices for cable bundles, firestopping putty, plugs, or pillows.

M. Retrofit Device for Cable Bundles: Factory-made, intumescent, collar-like device for firestopping existing over-filled cable sleeves and capable of being installed around projecting sleeves and cable bundles.

N. Wall-Opening Protective Materials: Intumescent, non-curing putty pads or self-adhesive inserts for protection of electrical switch and receptacle boxes.

O. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestopping gasket for use around rectangular steel HVAC ducts without fire dampers.

P. Firestopping Plugs: Flexible, re-enterable, intumescent, foam-rubber plug for use in blank round openings and cable sleeves.

Q. Fire-Rated Cable Grommet: Molded two-piece grommet made of plenum-grade polymer and foam inner core for sealing small cable penetrations in gypsum walls up to 1/2 inch (13 mm) in diameter.

R. Closet Flange Gasket: Molded, single-component, flexible, intumescent gasket for use beneath a water closet (toilet) flange in floor applications.

2.5 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings in accordance with manufacturer's written instructions and with the following requirements:

1. Remove foreign materials from substrate surfaces that could interfere with adhesion of penetration firestopping materials.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates in accordance with penetration firestopping system manufacturer's written installation instructions, using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems in accordance with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

1. end of wall and at intervals not exceeding 30 ft. (9.14 m).

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed.

3.5 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes joint sealants.

B. Work includes
1. All joints indicated graphically as sealant or labeled sealant.
2. Housekeeping sealant between all plumbing fixtures and wall surfaces; this work is not indicated on the drawings.
3. All joints between interior architectural woodwork, finish carpentry items, and equipment and specialties required to close gaps and variations in the substrate.
4. All exterior sealant joints in concrete pavement

C. Related Sections:
1. Section 088000 "Glazing" for glazing sealants.
2. Section 092900 "Gypsum Board" for sealing perimeter joints.
3. Section 095100 "Acoustical Tile Ceilings" for sealing edge moldings at perimeters with acoustical sealant.
4. Division 30 Section “Concrete Paving” for coordination with construction and isolation joints.

1.2 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. 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.

D. Qualification Data: For qualified Installer.

E. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

F. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

H. Field-Adhesion Test Reports: For each sealant application tested.

I. Warranties: Sample of special warranties.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.4 PROJECT 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[or are below 40 deg F (5 deg C)].
   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.

1.5 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

   1. Warranty Period: (2) two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

   1. Warranty Period: (20) twenty years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, 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.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dow Corning Corporation; 790.
      b. Pecora Corporation; 301 NS.
      c. Sika Corporation, Construction Products Division; SikaSil-C990.
      d. Tremco Incorporated; Spectrem 1
   2. For use on vertical building applications were the joint does not receive paint.

B. Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use T.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dow Corning Corporation; 790.
      b. Pecora Corporation; 301 NS
      c. Tremco Incorporated; Spectrem 800.
   2. For use on interior floor surface joints.

C. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant (Option 1): ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dow Corning Corporation; 786 Mildew Resistant.
      b. Tremco Incorporated; Tremsil 200 Sanitary.
   2. For use between all plumbing fixtures and adjacent wall surfaces including but not limited to toilets, urinals, and wall mounted lavatories.

D. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant (Option 2): ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Pecora Corporation; 898.
      b. Or equal.
   2. For use on all joints between counters, trim, and interior surfaces not scheduled to receive paint.

2.3 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Bostik, Inc.; Chem-Calk 600.
      b. Pecora Corporation; AC-20+.
      c. Tremco Incorporated; Tremflex 834.
   2. For use on all joints between counters, trim, and interior surfaces not scheduled to receive paint.

2.4 URETHANE JOINT SEALANTS

A. Urethane Horizontal Joints: Multicomponent, self-leveling, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Meadows, W. R., Inc.; POURTHANE.
      b. Pecora Corporation; Urexpan NR-200.
      c. Sika; Sikaflex-2c SL.
      d. Tremco Inc.; THC-901.
      e. Or approved equal
   2. Extent of Use: Exterior joints in horizontal surfaces, exterior slabs-on-grade, and concrete sidewalks.

B. Urethane Vertical Joints, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Pecora Corporation.
      b. Sika Corporation; Joint Sealants.
      c. Tremco Incorporated.
      d. Or approved equal
   2. Extent of Use: Exterior and interior joints subject to painting

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated 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.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean, porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
      a. Concrete.
      b. Masonry.
   3. Remove laitance and form-release agents from concrete.
   4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
      a. Metal.
      b. Glass.
      c. Porcelain enamel.
      d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by 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.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support 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 sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet 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.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
      a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. 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 so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Interior standard steel doors and frames.
   2. Exterior standard steel doors and frames.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

C. Section 011401 Phasing is part of the Work of this Section.

D. Related Requirements:
   1. Section 087100 "Door Hardware for door hardware for hollow-metal doors.
   2. Section 088001 “Glazing” for glazing installed in hollow metal doors and frames
   3. Section 099001 “Painting” for field painting of hollow metal doors and frames.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, core descriptions, and finishes.

B. Shop Drawings: Include the following:
   1. Elevations of each door type.
   2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
   7. Details of anchorages, joints, field splices, and connections.
   8. Details of accessories.
   9. Details of moldings, removable stops, and glazing.

C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule. SUBMITTALS NOT FOLLOWING THE REFERENCE NUMBERS, TYPES AND HARDWARE SETS INDICATED IN THE DOCUMENTS WILL BE RETUNRED WITHOUT REVIEW.

1.6 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ceco Door; ASSA ABLOY.
   2. Curries Company; ASSA ABLOY.
   3. DE LA FONTAINE.
   4. Fleming Door Products Ltd.; Assa Abloy Group Company.
   5. Or approved equal

2.2 PERFORMANCE REQUIREMENTS

A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft. when tested according to ASTM C518.

B. All exterior doors at the bathhouse building shall be thermally rated.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.
   1. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches (44.5 mm).
      c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
      d. Edge Construction: Model 1, Full Flush and Model 3, Stile and Rail].
      e. ANSI/SDI A250.8 allows the edge bevel to be determined by manufacturer unless otherwise indicated.
      f. Edge Bevel: Provide manufacturer's standard beveled or square edges.
      g. Core: Polystyrene
   2. Frames:
      a. Materials: Metallic-coated] steel sheet, minimum thickness of 0.053 inch (1.3 mm).
      b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
      c. Construction: Full profile welded
   3. Exposed Finish: Prime

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.
   1. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches (44.5 mm).
      c. Revise "Face" Subparagraph below if embossed or textured faces are required.
      d. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180)] coating.
      e. Edge Construction: Model 1, Full Flush and Model 3, Stile and Rail.
      f. Edge Bevel: manufacturer's standard beveled or square edges.
      g. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
      h. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.

Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.

i. Core: Polyurethane

2. Frames:
   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053-inch (1.3 mm), with minimum A60 (ZF180) coating.
   b. Construction: Full profile welded.
3. Exposed Finish: Prime

2.5 BORROWED LITES

A. Fabricate of metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm.

B. Construction: Full profile welded.

2.6 HOLLOW-METAL PANELS

A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.7 FRAME ANCHORS

A. Jamb Anchors:
   1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
   2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
   3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

2.8 MATERIALS

A. Glazing: Comply with requirements in Section 088000 "Glazing."

2.9 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.

2.10 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.11 LOUVERS

A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.
   1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.

B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
   1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
b. Install frames with removable stops located on secure side of opening.

2. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
3. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors.
4. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Engage a qualified inspector to perform inspections of the installations including the door hardware and to furnish reports to Architect prior to requesting an punchlist inspection.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081213.01 – CUSTOM HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior custom hollow-metal frames to match existing profiles.
   2. Concealed hollow metal frames
   3. Borrowed lites.

B. Related Requirements:
   1. Section 081113 "Hollow Metal Doors and Frames" for hollow-metal doors and frames.
   2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
   3. Section 088000 " Glazing" for borrowed lites and sidelites

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site] <Insert location>.

1.5 ACTION SUBMITTALS

A. Product Data:
   1. Interior custom hollow-metal frames.
   2. Concealed hollow-metal frames.
   3. Borrowed lites.

B. Product Data Submittals: For each product.
   1. Include construction details, material descriptions, and finishes.

C. Shop Drawings: Include the following:

1. Elevations of each frame type.
2. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
3. Locations of reinforcement and preparations for hardware.
4. Details of each different wall opening condition.
5. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

D. Product Schedule: For hollow-metal frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 CUSTOM HOLLOW-METAL FRAMES

A. Interior Custom Hollow-Metal Frames: NAAMM-HMMA 861. At existing door openings.

1. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
2. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
3. Construction:
   a. Knocked down at existing opening.
   b. Full profile welded at new openings.
4. Exposed Finish: Prime.

B. Provide custom frame profiles that match existing door profiles.

2.2 BORROWED LITES

A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch.

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.3 FRAME ANCHORS

A. Jamb Anchors:
1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

2.4 CONCEALED DOOR FRAMES

A. Provide EzyJamb® Classic Adjust - EZC split type door jamb system. Two-piece adjustable jamb. or approved equal. https://ezconcept.com/products/ezyjamb/

B. Provide concealed hinges, coordinated with Section 087000.

2.5 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Glazing: Comply with requirements in Section 088000 "Glazing."

2.6 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors].
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

B. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule on Drawings, and templates.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior frames. Provide loose stops and moldings on inside of hollow-metal frames.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. General: Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions. Comply with NAAMM-HMMA 840.

B. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

C. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

D. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
   1. Squareness: Plus, or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   2. Alignment: Plus, or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   3. Twist: Plus, or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. Plumbness: Plus, or minus 1/16 inch (1.6 mm), measured at jambs at floor.

E. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 CONCEALED FRAMES

A. Install frames in strict accordance with manufacturer’s written instructions.

B. https://ezconcept.com/wp-content/uploads/sites/5/2021/10/EzyJamb-EZC-Installation-Instructions-US.pdf

3.4 CLEANING AND TOUCHUP

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081213.01

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SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid-core five-ply flush wood doors and transom panels for opaque finish.
   2. Light frames and louvers.

B. Related Requirements:
   1. Section 08 11 13 “Hollow Metal Doors and Frames: for mounting flush wood doors in metal frames.
   2. Section 088000 "Glazing" for glass view panels in flush wood doors.
   3. Section 099100 "Painting” for field finishing doors.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Solid-core five-ply flush wood doors and transom panels for opaque finish.
   2. Light frames and louvers.

B. Product Data Submittals: For each product, including the following:

   1. Door core materials and construction.
   2. Door edge construction
   3. Door face type and characteristics.
   4. Door louvers.
   5. Door trim for openings.
   6. Factory-priming

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

   1. Door schedule indicating door location, type, size, , and swing.
   2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
   3. Dimensions and locations of mortises and holes for hardware.
   4. Clearances and undercuts.
   5. Doors to be factory primed and application requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.4 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.
2. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between [25 and 55] [43 and 70] [17 and 50] <Insert numbers> percent during remainder of construction period.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
2. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 SOLID-CORE FIVE-PLY FLUSH WOOD DOORS FOR OPAQUE FINISH

A. Exterior Doors, Solid-Core Five-Ply for Opaque Finish: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to:
1. Lambton Doors
2. Fotet Opening Solutions, Cendura Series, (formerly Masonite and associated brands)
3. Oregon doors
4. VT Industries
5. Or approved equal

B. Door Construction:
1. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty
2. Faces: MDO or Any closed-grain hardwood of mill option.
a. Apply MDO to standard-thickness, closed-grain, hardwood face veneers.
3. Exposed Vertical and Top Edges: Any closed-grain hardwood.
4. Core:
a. recommended for exterior doors.
b. ANSI A208.1, Grade LD-1 particleboard or WDMA I.S. 10 structural composite lumber

5. Construction: Five plies, hot-pressed, bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.
6. Adhesives: Type I in accordance with WDMA T.M. 6.

2.2 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Any closed-grain hardwood.
2. Profile: Flush rectangular beads.

2.3 FABRICATION

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.4 FACTORY PRIMING

A. Doors for Opaque Finish: Factory prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099110 "Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Job-Fitted Doors:
   1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
      a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
   2. Machine doors for hardware.
   3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
   4. Clearances:
      a. Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors.
      b. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
      c. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
   5. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes access doors and frames for walls and ceilings.

1.2 FILED SUB-BID SECTIONS

A. Work of this Section shall be provided by individual Filed Sub bid Sections including:
   1. Section 210000- Automatic Fire Protection
   2. Section 220000- Plumbing
   3. Section 230000- HVAC
   4. Section 260000- Electrical

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Product Schedule: For access doors and frames.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Acudor Products, Inc.
   2. Babcock-Davis.
   3. Dur-Red Products.
   4. JL Industries (a division of Activar Construction Products Group).
   5. Karp Associates, Inc.
   6. Larsen's Manufacturing Company.
   7. Milcor Inc.
   8. Nystrom, Inc.
   9. Or approved Equal

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges

1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
2. Locations: Wall and ceiling
3. Door Size: As required to provide access to service equipment, valve, drain down, test location, etc.
4. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage, factory primed.
5. Frame Material: Same material, thickness, and finish as door
6. Latch and Lock: Cam latch, hex-head wrench operated

B. Flush Access Doors with Concealed Flanges (Public Areas in GWB partitions and ceilings)
1. Manufacturers:
   a. Acudor Products, Inc.
   b. Babcock-Davis
   c. JL Industries
   d. Karp Associates, Inc.
   e. Milcor, Commercial Products
   f. Nystrom, Inc.
   g. Or approved equal
2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: 12 by 12, size to meet required access function.
5. Uncoated Steel Sheet for Door In Wall Applications: Nominal 0.060 inch (1.52 mm), 16 gage factory primed.
6. Metallic-Coated Steel finished.
7. Latch and Lock: Cam latch, pinned-hex-head wrench operated.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

D. Latch and Lock Hardware:
1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

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SECTION 083313 - COILING COUNTER DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Counter door assemblies.

B. Related Requirements:
   1. Section 06100 "Rough Carpentry" for door-opening framing and corner guards.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of coiling counter door and accessory.

   1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
   1. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.

1. Obtain operators and controls from coiling counter door manufacturer.

2.2 COUNTER DOOR ASSEMBLY

A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Cookson; a Cornell/Cookson company.
b. Cornell; a Cornell/Cookson company.
c. McKeon Door Company.
d. Overhead Door Corporation.
e. Or approved equal

B. Door Curtain Material: Galvanized steel

C. Door Curtain Slats: Flat profile slats of 1-1/2-inch center-to-center height.
1. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

D. Bottom Bar: Shall consist of a single steel angle not less than 1½” x 1½” formed to fit slats.

E. Guides: Each guide assembly shall be fabricated of a minimum 1/8” steel angles and channels formed to a box type configuration.

F. Mounting Brackets: Fabricated of hot rolled 1/8” steel plate minimum, brackets shall be provided to house ends of the counterbalance barrel assembly.

G. 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.

H. Counterbalance Assembly: Counter shutter 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.

I. 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 RAL powder coat selection chart.

2.3 DOOR CURTAIN MATERIALS AND FABRICATION

A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

2.4 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized-steel sheet with G90 (Z275) zinc coating, complying with ASTM A653/A653M.

2.5 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

PART 3 - EXECUTION

3.1 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.

3.2 INSTALLATION

A. Perform installation using only factory approved and certified representatives of the counter shutter manufacturer.

B. Install counter shutter assemblies at locations shown in perfect alignment and elevation, plumb, level, straight and true.

C. Adjust counter shutter installation to provide uniform clearances and smooth non-binding operation.

3.3 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.

END OF SECTION 083313

SECTION 084236 BRONZE ENTRANCE DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Work included: Entrance doors consisting of doors, pivots, weatherstripping, seals, astragal, and thresholds, operating mechanisms and all finish hardware as shown on the drawings and specified herein.

B. Related work:
   1. Section 07 92 00, “Joint Sealants”; at interface of entrance assemblies and other building components.
   2. Section 08 71 00 Door Hardware;” other than hardware specified as part of entrance assemblies, cylinders; coordination with security system.

1.3 QUALITY ASSURANCE

A. The manufacturer must have been regularly engaged in the manufacture of bronze doors for a period of no less than ten (10) years.

1.4 SUBMITTALS

A. Shop drawings including elevations and plans, one-half size detail sections of typical composite members, hardware arrangement details and interaction with surrounding material.

B. Two (2) finish samples shall be submitted:
   1. Bronze, #6 satin with lacquer.

1.5 WARRANTY

A. All finished hardware and material not fabricated by door manufacturer to carry manufacturer’s standard warranty.

B. All door manufacturer material furnished and installed to these specifications, including the door operating mechanisms, shall be warranted against defective material and workmanship for a period of ten (10) years from date of substantial completion.
   1. This warranty is not intended to cover adjustments made necessary by the shifting or settling of the building structure.

2. This warranty is not intended to cover the breakdown of protective coatings when furnished to the architect's specification and applied as directed.

1.6 DELIVERY, STORAGE AND HANDLING

A. Materials shall be packed, unloaded, stored and protected to avoid abuse and damage.

B. Protect finished surfaces with wrapping and/or strippable coating.

C. When unloading, remove all paper type wrappings that are wet or which could become wet.

D. Store inside, if possible, in clean well drained area free of dust and corrosive fumes.

E. Stack vertically or on edge so that water cannot accumulate on or within materials, using wood or plastic shims between components to provide water drainage and air circulation.

F. Cover materials with tarpaulins or plastic hung on frames to provide air circulation.

G. When installing protect materials from lime, mortar, run-off from concrete and copper, weld splatter, acids, roofing tar, solvents and abrasive cleaners.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGNN MANUFACTURER

A. Ellison Bronze, Inc; 125 W. Main Street, Falconer, NY 14733. Phone: (800) 665-6445 Fax: (716) 665-5552
1. Web site: www.ellisonbronze.com. Email: info@ellisonbronze.com

2.2 MATERIALS AND FINISHES

A. Material: Bronze (muntz metal, alloy #280) or naval brass (alloy #464).

B. Finish:
1. Bonze, #6 satin with lacquer.

2.3 DOORS

A. Doors:
1. Door thickness: 2 inch (51 mm).
2. Stiles: as indicated on drawings
3. Top rail: as indicated on drawings
4. Bottom rail: as indicated on drawings
5. Intermediate horizontal bronze rails; as indicated on drawings
6. Bronze door bodies shall be formed from a minimum of .09 inch (2 mm) thick material.

7. Formed bronze doors shall have .09 inch (2 mm) thick continuous tie channel frame spot-welded into door body.
8. Seams between stiles and rails shall be welded and finished to an invisible joint.
9. Door top and bottom rails shall have spot-welded in .09 inch (2 mm) thick reinforcement channels.
10. All reinforcing material to be bronze and welded to door body. Aluminum, plastic or other glued-in reinforcements or stiffeners are unacceptable.

B. Door Insert Panels
1. Provide insulated panel with bronze facing matching door finish.
2. Insert Panel stops: Custom applied trim-stop. Provide profile as shown on drawings. Finish to match door bronze.

2.4 HARDWARE AND WEATHERSTRIPPING

A. Hardware:
1. The operating mechanism in the head shall include ball bearing pivots, cast hydraulic check and cast door guide channel with minimum dimensions of 2-3/8 inch (60 mm) by 3/4 inch (19 mm) thick and a minimum wall thickness of 9/16 inch (14 mm).
   a. Means shall be provided which make possible field adjustment for proper perimeter clearance of each door leaf in relation to its finished framework to accommodate on-site conditions.
   b. All doors shall have a semi-automatic hold open device located in the bottom rail.
2. Hardware finish: Cast Bronze

B. Finish hardware by door manufacturer include
1. Door Pulls
2. Exit Device
3. Electric strikes
4. Automatic door opener:
5. Door closer
6. Overhead stop

C. Thresholds:
1. Provide at all doors unless otherwise detailed.
2. Provide screw and rawl plug type fastenings approximately 15 inches (381 mm) on center.
3. Thresholds shall be set on the finished floor and adequately caulked against water seepage.
4. Profile:
   a. Thresholds shall be 1/2 inch (13 mm) high x 6 inch (152 mm) wide saddle type.
5. Material: Extruded or formed bronze.

D. Weatherstrip:
1. Shall be manufacturer’s standard polypropylene pile.
2. Shall occur:
   a. Vertically at meeting stiles on pairs of doors.
   b. Concealed at door top and bottom rails.
   c. At door stops at both hinge and strike jambs.
   d. At both sides of exposed hinge shaft if used.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The installer/erector shall examine substrates, supports and conditions under which this work is to be performed and notify contractor, in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

B. The floor material shall be solid (not susceptible to either deterioration or heaving), smooth and level and the adjacent work in its proper place prior to the installation of the door and frame system.

C. Coordination dimensions, tolerances and method of attachment with other work.

D. Verify electric power is available and of correct characteristics, if required.

3.2 INSTALLATION/ERECTION

A. The installer/erector to install all materials by factory-trained personnel in strict accordance with installation data provided by manufacturer and these specifications.

3.3 ADJUSTING AND CLEANING

A. The installer/erector to fit, align and adjust door assembly.

B. Adjust door installation and hardware so that doors open and close smoothly.

C. Adjust speed to comply with applicable codes.

D. Remove protective materials from finished metal surfaces.

E. Clean exposed surfaces using materials and methods recommended by manufacturer, exercising care to avoid damage to coatings.

F. Touch-up damaged coatings and finishes.

3.4 PROTECTION

A. The contractor to institute protective measures required throughout the remainder of the construction period to ensure that the balanced door units will be without damage or deterioration, other than normal weathering, at the time of substantial completion.

END OF SECTION 084236

SECTION 085350 - POLYMER WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Polymer windows.

1.3 DEFINITIONS

A. Combination Assemblies: An assembly formed by a combination of two or more separate fenestration products whose frames are mulled together utilizing a combination mullion or reinforcing mullion.

B. Reinforcing Mullions: A horizontal or vertical member with an added continuous mullion stiffener and joining two or more individual fenestration units along the sides of the mullion stiffener.

1.4 REFERENCES

A. Publications listed below are part of this specification to the extent they are referenced. When publications are cited in these specifications by use of shortened names or by standard number alone, it must be understood that reference is made to the full publication and edition as listed here.

B. AAMA/WDMA/CSA 101/I.S.2/A440-08/12: North American Fenestration Standard/Specification for windows, doors, and skylights (use appropriate specifications depending on certification for each product type).

C. NFRC: National Fenestration Rating:
   1. 100: Procedure for Determining Fenestration Product U-Factors
   2. 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence
   3. 500: Procedure for Determining Fenestration Product Condensation Resistance Values

D. E 90-09: Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

E. E 413: Classification for Rating Sound Insulation

F. E 1332: Standard Classification for Rating Outdoor-Indoor Sound Attenuation

G. E 2235-04 (2012): Standard Test Method for Determination of Decay Rates for Use in Sound Insulation Test Methods

H. E 2190: Standard Specification for Insulating Glass Unit Performance Evaluation.

I. ANSI Z97.1-2015, CPSC 16 CRF 1201 (1977), & CAN/CGSB 12.1-M90 (1990)

1.5 PERFORMANCE REQUIREMENTS

A. Windows shall meet a rating of DP 70 psf specifications in accordance with ANSI/AAMA/NWWDA 101/I.S.2/A440-08/12.

B. Windows Air Leakage, ASTM E 283: Window air leakage when tested at 70 psf (Fixed), 70 psf (Operable) shall be 0.1 cfm/ft2 (Fixed), 0.1 cfm/ft2 (Operable) or less.

C. Windows Water Penetration, ASTM E 547, and ASTM E 331: No water penetration through window when tested under static pressure of 12.11 psf (Fixed), 12.11 psf (Operable).

D. Thermal Performance: Windows have been tested in accordance with the NFRC. The products were evaluated in full compliance with NFRC requirements. The Windows, including glass and Polymer framing, shall have a thermal transmittance of:
   1. U-factor (Btu/hr/ft2/°F): Fixed: 0.14, Operable: 0.21.
   2. SHGC: Fixed: 0.10, Operable: 0.10
   3. VT: Fixed: 0.18, Operable: 0.18

1.6 THERMAL PERFORMANCE

A. Allow for thermal movement of the window based on site mean temperature +/- 70 F, window/element size and coefficient of linear expansion of Polymer.
   1. If non-white windows are chosen, allow for thermal movement of the window based on solar-heat absorption.

1.7 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

   1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review, discuss, and coordinate interrelationship of Polymer windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
   3. Review and discuss sequence of work required to construct a watertight and weathertight exterior building envelope.
   4. Inspect and discuss condition of substrate and other preparatory work performed by other trades.

1.8 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes.

B. Shop Drawings:
   1. Plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish:
   1. Exposed Finishes: 2 by 4 inches.
   2. Exposed Hardware: Full-size units.

E. Product Schedule: For Polymer windows. Use same designations indicated on Drawings.

F. Delegated Design Submittals: For reinforcing mullions, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.9 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of Polymer window, for tests performed by manufacturer and witnessed by a qualified testing agency.

B. Field Quality-Control Reports: For Polymer windows.

C. Qualification Statements: For manufacturer and Installer.

D. Delegated Design Engineer Qualifications: For reinforcing mullions.

E. Sample warranties.

1.10 CLOSEOUT SUBMITTALS

A. Warranty Documentation:
   1. Manufacturers' special warranties.

1.11 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating Polymer windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

B. Installer Qualifications: Authorized representative who is trained and approved by Polymer window manufacturer.

C. Testing Agency Qualifications: An FGIA-accredited testing agency for testing indicated.

D. Obtain Polymer windows from single source from single manufacturer.

1.12 STORAGE AND HANDLING

A. Products are heavy and fragile. Special care, sufficient manpower, tools, and equipment shall be used for unloading, transporting, warehousing, and installing the products. Two forklifts should be used to unload container on job site.

B. Industrial straps (at least 5,000 lbs.) MUST be used to unload large pallets.

C. Store window units in an upright position in a clean and dry storage area above ground to protect from weather.

D. Cover materials with tarpaulins or plastic hung on frames to provide air circulation and prevent contaminants from contacting polymer.

E. Remove all paper type wrappings and interleaving that are wet or which could become wet when unloading materials.

F. Glass must never be stored or transported in a horizontal/flat orientation.

G. Store crated glass in a cool, dry, and well-ventilated area where it will not be subject to rain or direct sun.

H. Minimize handling by scheduling shipments by floors and by initially locating crated products as close to their installation as possible.

I. Use mechanized window handling and installation equipment with vacuum suction cups for windows heavier than 150 lbs.

J. Refer to manufacturer’s written handling and storage instructions.

1.13 WARRANTY (BASED ON BASIS-OF-DESIGN MANUFACTURER)

A. The products supplied by Seller shall be free from material defects, in material and workmanship, for a period of 10 years from the date of substantial completion of the project.

B. Clear insulating glass with stainless steel or warm edge spacers is warranted against seal failure resulting in visible obstruction through the glass for years from the SOW date under the normal use conditions. Glass is warranted against stress cracks caused by manufacturing defects for one (1) year from the SOW date

C. The polymer white profiles without laminate will resist cracking, peeling, chalking, blistering, flaking, and significant ultraviolet discoloration (greater than 6 Delta E) caused by natural environmental atmospheric conditions for the period of 5 years from the SOW date.

D. The polymer laminated exterior finishes (using Renolit EXOFOL FX films) will resist cracking, peeling, chalking, delaminating, blistering, flaking, and significant ultraviolet discoloration

(greater than 6 Delta E) caused by natural environmental atmospheric conditions for the period of 10 years.

E. Non-glass components are warranted to be free from manufacturing defects for 5 years from the SOW date.

F. Finish Warranty:
1. AAMA 2605 finish is warranted for a period of years from the SOW date.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer:
1. INTUS Windows: 2720 Prosperity Ave Suite 400-1, Fairfax, Virginia 22031. 1-888-380-9940. www.INTUSWindows.com.

B. Configurations:
1. Fixed
2. Combination Units: Fixed over Awning
3. Double mulled units where indicated

C. Other manufacturers offering windows similar to the basis of design include.
1. Rehau Windows, https://www.rehau.com/us-en/windows
   a. Series 4700
2. Quaker Commercial Windows https://www.quakercommercialwindows.com/v300-products/
   a. V300 Series
3. Or approved equal

2.2 MATERIALS

A. Window system: Supera , fixed, in-swing casement window.

B. Minimum Outside Nominal Wall Thickness:
1. Primary frame and sash extrusions exterior walls: 0.106” (2.7mm)
2. Secondary extrusions (e.g., glazing stops and closures): 0.059” (1.5mm)

C. Face dimensions (nominal): as indicated on Architectural Drawings.

D. The frames feature accessory grooves which allow for snap-in attachment of Polymer nailing flange, trim profile(s), and mulled window joint covers.

E. Window Sash and Frame shall be configured to receive glazing beads (stops) that snap into the interior side of the insulating glass.

F. Reinforcement:

1. Galvanized steel shall be in size, configuration, and location within the window as indicated in the test reports and INTUS Windows Supera Reinforcement instructions.

G. Weather seals:
1. Co-extruded polymer replaceable weather seals:
2. Shapes, designs, and thickness as needed to satisfy performance requirements
3. Standard color: black

H. Glass:
1. Glass shall comply with requirements of AAMA/WDMA/CSA 101.I.S.2/A440-05, Section 10.2
2. Insulating glass panels shall have an overall nominal thickness of 0.94" (24mm) – 1.575" (40mm); triple glazed
3. Glazing type: tempered.
4. Glass type: clear, low-e coated
5. Filling: Argon
6. Spacer: Warm edge spacer

I. Hardware
1. Provide manufacturer's standard single handle turn-tilt multi-point locking system. Locking points interact with a manually operated handle to bring window sashes into a turn or a tilt position.
2. Standard hardware is used for securing window sashes and to position them in different ventilation positions. Normally it is necessary to overcome the counter force of a seal when closing. Any other type of usage is not in accordance with the intended application. Windows for special applications (i.e., burglar-resistance or for installation in humid conditions / in environments with corrosive atmospheric substances) require special fittings with separately agreed performance criteria, designed for the particular application.
3. Handle: Provide standard handle. Standard Color: White
4. Limiters: 4″ limiter without friction, 4″ limiter with friction
5. Fasteners
   a. Exposed fasteners shall be selected to prevent galvanic reaction with any reinforcement materials fastened.
   b. Above criteria is applicable to screws used to secure internal reinforcement and to fasteners used in window mulling connections, if required.
   c. Avoid exposed fasteners to greatest extent possible.
   d. Where exposed fasteners are unavoidable in finished surfaces, use flathead countersunk Phillips head screws.
   e. Installation anchors must be approved by the responsible engineer/architect for the project.
6. Insect Screen
   a. Aluminum frame profile with fiberglass net.
   b. Frame finish: to match the exterior window frame finish.
   c. Net finish: grey
   d. Shipped separately, installed by the Contractor.
   e. Insect screens are mounted on the outside of the window. They must be removable from the inside.
7. Installation accessories:
   a. Mounting brackets and screws
8. Finish

a. Application of laminated color foils from RENOLIT shall be performed under specification issued by RENOLIT and INTUS Windows
b. All exterior laminates shall be RENOLIT FX grade.
c. The laminated surface shall be uniform and free from streaks, blisters, sags, or other surface imperfections
d. Standard Colors: To be selected from White, Dark Bronze, Smooth Black, Warm Stone, Anodized Silver
e. Protection:
    1) Provide film to protect exposed finished surfaces during shipment, storage, and installation whenever possible
    2) Film shall not affect factory finish after finished component is installed and film is stripped, no residue, adhesive, or film covering, visual non-uniformity or other deleterious effects or substances shall remain on surfaces
    3) Factory applied protective film must be removed immediately after installation
    4) When cleaning agents/paint etc. are applied to the building the windows must be protected

2.3 ACCESSORIES

A. Panning Trim or fillers: Profiles in sizes and configurations indicated on Drawings.

B. Panning shall be manufactured from:
    1. Polymer material matching window style and color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, air and weather barriers, and other built-in components to ensure weathertight window installation.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Mullions: Install combination and reinforcing mullions for combination assemblies in accordance with manufacturer's written instructions.

D. 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.

E. Testing Services: Testing and inspecting of installed windows to take place as follows:
   1. Testing Methodology: Testing of windows for air infiltration and water resistance will be performed in accordance with AAMA 502.
   2. Air-Infiltration Testing:
      a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
      b. Option in "Allowable Air-Leakage Rate" Subparagraph below is AAMA 502 default.
      c. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
   3. Water-Resistance Testing:
      a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
      b. Allowable Water Infiltration: No water penetration.
   4. Testing Extent: Two (2)window(s) of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows will be tested immediately after installation.

F. Test and Inspections:
   1. Windows will be considered defective if they do not pass tests and inspections.

3.3 ADJUSTING

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

3.4 CLEANING AND PROTECTION

A. Clean exposed surfaces immediately after installing windows using manufacturer's written instructions. Remove excess sealants, glazing materials, dirt, and other substances.

B. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085350

SECTION 086200 - UNIT SKYLIGHTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Unit skylights.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include product dimensions, construction details, material descriptions, dimensions and profiles of components, and finishes.

B. Shop Drawings:
   1. Include plans, elevations, sections, mounting, and attachment details and methods of structural support.

C. Product Schedule: For each type of product specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type and size of product, for tests performed by a qualified testing agency on specimens equal to or greater than sizes required for Project.

B. Evaluation Reports: Indicating product compliance with code requirements of authorities having jurisdiction.

C. Field quality-control reports.

D. Sample Warranty: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For products and accessories to include in maintenance manuals.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of products that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure to meet performance requirements.
   b. Water leakage not controlled by drainage features.
   c. Deterioration of materials and finishes beyond normal weathering.
   d. Yellowing of acrylic glazing.

2. Warranty Period:

   a. Products and Accessories: Fifteen (15) years from date of Substantial Completion.

B. Special Aluminum Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of finish deterioration within specified warranty period.
1. Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
   c. Cracking, peeling, checking, or chipping.
2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 UNIT SKYLIGHTS – S1

A. Factory-Assembled Skylight: Curb-mounted unit that includes glazing, extruded-aluminum glazing retainers, gaskets, and inner frame.

1. Basis-of-Design Product: Subject to compliance with requirements, provide
   Velux America LLC; Curb Mount CWS3)]
   Unit Skylights or comparable product by one of the following:
   a. American Skylights, Inc.
   b. Birdview Skylights.
   c. Wasco Products, Inc.
   d. Or approved equal

B. Integral Curb: Manufacturer’s standard formed aluminum, including flashing flange to receive roof flashing and counter flashing.
1. Height: 12 inch inches above roof surface.

C. Condensation Control: Fabricate skylight units with integral internal gutters and weeps to collect and dispose of condensation.

D. Skylight and curb assembly to have a minimum U-factor of 0.66 per NFRC 102 for double dome and U-factor of 0.50 for triple dome.

E. Thermal Break: Fabricate skylight units with thermal chambered PVC frame.

F. Shape and Size: As indicated by model number.

G. Outer Glazing: Dome thermoformed:
1. Acrylic clear

H. Middle Glazing (for triple domes only): Dome thermoformed:
1. Acrylic Clear

I. Inner Glazing: Dome thermoformed:
1. Acrylic clear

2.2 FABRICATION

A. Framing Components: As follows:
1. Factory fit and assemble components.
2. Fabricate components to drain condensation to the exterior.
3. Fabricate components to ensure that glazing is thermally and physically isolated from framing members.
4. Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.

2.3 ALUMINUM FINISHES

A. General: Comply with NAAMM “Metal Finishes Manual” recommendations for application and designations of finishes.

B. Finish designations prefixed by AA conform to the system for designations of aluminum finishes established by the Aluminum Association.
1. 2605 Powder: Powder Coat High-Performance Architectural Coating complying with AAMA 2605. Color to match roofing membrane

2.4 FALL PROTECTION

A. Provide exterior safety screens mounted to skylight frame. Provide CAEQ/CAEB Exterior Safety Screens.

2.5 ACCESSORY MATERIALS

A. Fasteners: Same metal as metal being fastened, nonmagnetic stainless steel, or other noncorrosive metal that is compatible with the materials being fastened and as recommended in writing by manufacturer. Finish exposed fasteners to match material being fastened.

1. Where removal of exterior exposed fasteners might allow access to building, provide nonremovable fastener heads.

B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate installation of products and accessories with installation of substrates, vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight.

B. Install products and accessories to comply with recommendations in AAMA 1607 and with manufacturer's written installation instructions.

C. Install products true to line and without distortion.

D. Anchor products securely to supporting substrates.

E. Where metal surfaces of products will contact other metal or corrosive substrates, such as preservative-treated wood, apply bituminous coating on concealed metal surfaces or provide other approved permanent separation recommended in writing by manufacturer.

3.3 CLEANING AND ADJUSTING

A. Clean exposed product surfaces in accordance with manufacturer's written instructions. Touch up damaged metal coatings and finishes.

B. Remove excess sealants, glazing materials, dirt, and other substances.

C. Remove and replace glazing that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect product surfaces from contact with contaminating substances resulting from construction operations.

END OF SECTION 086200

SECTION 087100 - DOOR HARDWARE

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: Door hardware for wood doors, steel doors, aluminum framed entrance doors, all glass entrance doors, and miscellaneous hardware items.

B. Provide hardware not described herein but otherwise required for proper completion of the project, conforming to size, function, quality, and finish of other specified hardware.

C. Related Requirements: Refer to the following related specification sections (and sub-sections) for further information and proper coordination with door hardware.

	SECTION	TITLE
1.	042000	"Unit Masonry" – *for door frame anchors.*
2.	051000	"Structural Metal Framing" – *for door frame anchors.*
3.	061000	"Rough Carpentry" – *for door frame anchors.*
4.	062000	"Finish Carpentry" – *for door frame casing.*
5.	081113	"Hollow Metal Doors and Frames"
6.	081123	"Bronze Doors and Frames"
7.	081416	"Flush Wood Doors"
8.	08 8000	"Glazing" – *for door lite kits and sidelites.*
9.	089000	"Louvers and Vents" – *for door louvers.*
10.	102213	"Wire Mesh Partitions" – *for pedestrian doors with hardware.*
11.	102600	"Wall and Door Protection"
12.	210000	"Fire Protection" – *for fail safe doors tied to fire alarm system.*
13.	260000	"Electrical" – *for door hardware requiring power.*
14.	280000	"Electronic Safety and Security" – *for interface of access control devices with access control system and fire alarm system.*
15.	323100	"Fences and Gates" – *for pedestrian doors with hardware.*

1.2 REFERENCED STANDARDS

A. American Association of Automatic Door Manufacturers (AAADM).

B. American National Standards Institute (ANSI):

1. A117.1 Accessible and Usable Buildings and Facilities

C. Americans with Disabilities Act (ADA) Standards for Accessible Design.

D. Builders Hardware Manufacturers Association (BHMA):

1. A156 Door Hardware Series of Standards *(See Section 2.3)*

E. Door and Hardware Institute (DHI):
   1. ANSI/DHI/A115.IG Installation Guide for Doors and Hardware
   2. DHI Keying Systems and Nomenclature.
   3. DHI Sequence and Format for the Hardware Schedule.

F. International Building Code (IBC)

G. Massachusetts Architectural Access Board (AAB, 521 CMR)

H. National Fire Protection Association (NFPA):
   1. 70 National Electrical Code
   2. 80 Fire Doors and Fire Windows
   3. 252 Fire Tests of Door Assemblies.

I. Underwriters Laboratories Inc. (UL):
   1. 10C Positive Pressure Fire Tests of Door Assemblies
   2. 3.5 Panic Hardware
   3. 1034 Burglary-Resistant Electric Locking Mechanisms

1.3 SUBMITTALS

A. Products other than those designated herein must be approved as substitutions prior to submittal of Door Hardware.

B. Door Hardware Schedule: Vertical format conforming to DHI “Sequence and Format for the Hardware Schedule.” Horizontal format schedules will be rejected without review. Format shall be ANSI Letter (8-1/2” x 11”) page size. Organize Schedule into headings, grouping doors to receive same hardware items, indicating quantity and complete designations of every item required for each door opening. The schedule shall include:
   1. Cover sheet indicating name and location of Project; name of Architect; name of Contractor; name, address and phone of Hardware Supplier, name of Hardware Consultant preparing the schedule; date of submittal or revised submittal.
   2. A list of abbreviations used in schedule.
   3. An index of door openings, listed in numerical order, with hardware heading identification cross-referenced to Architect’s set identification.
   4. Hardware headings shall be listed in numerical order corresponding, as closely as possible, with numerical order of Architect's set numbers.
   5. Each hardware heading shall have each door listed in numerical order according to door numbers in the Architect's door schedule, and denoting: location, configuration (single, pair, etc.), type (elevation, etc.), door and frame size(s), door and frame material(s), handing, fire rating, and key set identification.
   6. Type, complete model number, style, function, size, hand, and finish of each door hardware item.
   7. Manufacturer of each item.
   8. Fastenings and other pertinent information.

C. Manufacturer's Technical Product Data / Catalog Cut Sheets: Clearly marked for each hardware item, including installation details, material descriptions, dimensions of individual components and profiles, and finishes. Format shall be ANSI Letter (8-1/2" x 11") page size.

D. Wiring Diagrams: No later than 14 days after receipt of reviewed hardware schedule submittal, submit detailed wiring diagrams for power, signaling, monitoring, and control of the access control system electrified hardware or other system electrified components such as sensors, switches, or indicator/ strobe lights; identified by door number(s), and detailed specifically for each type and function of electrified door opening. Format shall be ANSI Letter (8-1/2" x 11") page size. Include the following:

1. System Description of Operation. Include description of component functions including, but not limited to, the following situations: normal secured/unsecured state of door; authorized access; authorized egress; unauthorized access; unauthorized egress; fire alarm and loss of power conditions, and interfaces with other building control systems.
2. Elevation single-line diagram, showing interface between electrified door hardware and fire alarm, power, access control, and security systems as applicable.
3. Point-to-point wiring diagram for field-installed wiring.

E. Keying Schedule: In accordance with Owner's final keying instructions for locks. Conform to DHI "Keying Systems and Nomenclature." Format shall be ANSI Letter (8-1/2" x 11") page size.

F. Operation and Maintenance Data: Provide complete operating and maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides.

G. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

H. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

B. Manufacturers, Hardware Suppliers, and Installers shall be licensed and certified with no less than five years of experience installing, commissioning, and maintaining door hardware, access control devices, and related accessories (including all of those specified herein); for projects similar in size, complexity and type.

C. Hardware Schedule and Keying Schedule submittals shall be prepared by a Hardware Consultant holding the credentials of Architectural Hardware Consultant (AHC) issued by the Door and Hardware Institute. Hardware Consultant shall have no less than five years experience in the scheduling of Door Hardware for projects similar in size, complexity and type to this Project; and shall be available, at no additional cost, during the course of the Work to consult with Contractor, Architect, and Owner regarding door hardware and keying.

D. Supplier shall submit samples indicative of door hardware to be supplied, as required by Architect and/or Owner. Samples to be advised by Architect shall include metal finishes, lever styles, door pulls, mounted locksets, accessories finishes, gasketing colors, etc.

1.5 REGULATORY REQUIREMENTS

A. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with all applicable regulations, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. At rated doors with panic exit devices, provide devices labeled as “Fire Exit Device.”

B. Comply with all applicable accessibility regulations as set forth in current/applicable versions of Americans with Disabilities Act (ADA); Accessibility Guidelines for Buildings and Facilities (ADAAG); and ANSI A117.1. 2010 Standards for Accessible Design, as applicable.

C. Latching and locking doors that are hand-activated and that are in a path of travel shall be operable with a single effort by lever-type hardware, panic bars, push-pull activating bars, or other hardware designed to be easy to grasp with one hand, not requiring tight grasping, tight pinching or twisting of the wrist; from egress side shall not require the use of a key, tool, or special knowledge for operation.

1. All hand-activated hardware shall be mounted between 34” and 48” above finished floor.

D. Door closing devices shall comply with the following maximum opening-force requirements:

	DOOR TYPES	MAXIMUM OPENING FORCE REQUIREMENTS
1.	Interior Swinging	5 lbf applied perpendicular to door at latch.
2.	Exterior Swinging	5 lbf applied perpendicular to door at latch.
3.	Fire-rated	5 lbf applied perpendicular to door at latch. To ensure latching, may be increased to the minimum force allowable by the appropriate administrative authority, not to exceed 15 lbf.

E. Where door closers are provided, adjust sweep speed so that from an open position of 90 degrees, the time required to move the door to a position of 12 degrees from the latch is 5 seconds minimum.

F. Thresholds shall be maximum 1/2” in height above floor and landing on both sides of openings. Bevel raised thresholds with a slope of not more than 1:2.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Each article of hardware shall be delivered individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule.

B. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

C. Hardware shall be stored in a dry, secure locked area, complete with shelving for unpacking and sorting of the door hardware.

D. Deliver all master keys by restricted, receipted delivery directly from the manufacturer to the Owner.

1.7 COORDINATION

A. Provide hardware templates to the parties involved for doors, frames, and other work specified to be factory prepared for door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. When required by door or frame fabricator, furnish physical samples of each mortised and recessed hardware item required.

C. Coordinate layout and installation of recessed pivots and closers with floor construction.

D. Electrical System Rough-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, and security system as applicable.

E. Pre-Installation Conference: Arrange conference at job site to coordinate door, frame, hardware and electronic security hardware installation; to be attended by the Architect, Owner, Contractor and representative personnel of firms involved in the provision and installation of said items.

F. Keying Conference: Arrange conference with Owner, or designated representative, and Manufacturer's/ Hardware Supplier's Architectural Hardware Consultant to establish keying requirements. Incorporate keying conference decisions into Keying Schedule.

1.8 WARRANTY

A. In addition to, and not precluding, other warranty requirements in the Contract Documents, the following hardware items shall carry extended minimum warranties as indicated:

1. Hinges: 10 years from date of Substantial Completion.
2. Locks: 5 years from date of Substantial Completion.
3. Exit Devices: 3 years from date of Substantial Completion.
4. Door Closers: 10 years from date of Substantial Completion.

1.9 MAINTENANCE

A. 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.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. All door hardware specified is subject to compliance with local jurisdictional requirements and regulations, including those described herein.

B. Equal and/or substitute products must meet the aesthetics, features, and functions of items specified as the basis-of-design in the Hardware Sets (Part 3).

C. Provide products by one of the following Acceptable Manufacturers listed below for each Hardware Type (sorted in order of standard door hardware scheduling sequence).

NOTE : Refer also to "ANNOTATIONS" Legend (symbols) in Section 3.12.

	PRODUCT TYPE (CLASSIFICATION):	**ACCEPTABLE MANUFACTURERS (SERIES):**
HANG	Butt Hinges	Best, Ives, McKinney
	Concealed Hinges	McKinney, SOSS, Tectus
	Continuous (Geared)	ABH, Best, Ives, NGP, Pemko
	Electrical Power Transfers	ABH, Securitron, Von Duprin
LOCK	Keying (Cylinders / Cores)	*per Owner/Facility Key System*
	Key Storage System	Key Control Systems, Lund, Telkee
	Mortise Locks (Grade 1)	Dorma (M9000), Sargent (8200), Schlage (L)
	Auxiliary Locks (e.g., deadbolts)	Arrow, Best, Schlage
PANIC	Pushpad Exit Devices (Grade 1)	Dorma (9000), Sargent (80), Von Duprin (98/99)
	Tubular Exit Devices (Aluminum / Glass Doors)	Access Architectural Hardware, ASSA ABLOY Glass Solutions, CR Laurence, Dorma, PRL Glass Systems
CLOSE	Surface Door Closers (Grade 1 Heavy Duty)	Dorma (8900), LCN (4010), Norton (7500), Sargent (351)
	Surface Door Closers (Grade 1 Medium/Standard Duty)	Dorma (8600), LCN (4030), Norton (8000), Sargent (1431)
	Cam Action / Track Arm Door Closers	Dorma (TS93), LCN (4040XPT), Norton (2800ST), Sargent (422)
AUTOMAT	Low Energy Automatic Operators (Surface, Low Profile)	Besam (SW150 Slim), Dorma (ED100/250), Nabco (GT20), Norton (6300)
	Actuators / Sensors / Bollards	All Manufacturers specified above; *plus* Alarm Controls, BEA, Securitron, Wikk Industries
STOP	Door Bolts and Coordinators (Automatic, Flush, Surface)	ABH, Ives, Rockwood, Trimco
	Mechanical Door Holders / Stops (Overhead, Concealed)	ABH, Glynn-Johnson, Rockwood, Rixson

PROTECT	Auxiliary Hardware	ABH, Ives, Rockwood
	Architectural Door Trim	ABH, Ives, Rockwood
	Door Bottoms, Metal Thresholds, Weatherstripping and Gaskets	NGP, Pemko, Zero
SECURE	☼ Electric Strikes (Frame/Jamb)	HES, RCI, Von Duprin
	☼ Electric Strikes (Overhead)	CRL, Folger Adams
	⚠ Motion Sensors	Alarm Controls, Securitron, SDC *by Security Vendor (per spec section 280000)*
	⚠ Card Readers and Credentials	*Compatible with Base Building Card Readers* *by Security Vendor (per spec section 280000)*
	⚠ Door Position Switches	G.E. Security, Securitron, SDC *by Security Vendor (per spec section 280000)*
	⚠ Access Control Accessories (e.g., buttons, switches, relays)	Alarm Controls, Securitron, SDC
	☼ Power Supplies for Electrified Door Hardware (Unsecured Doors)	Alarm Controls, Dormakaba, Securitron, SDC, Von Duprin.

2.2 MATERIALS AND FABRICATION

A. Requirements for grade, materials, size, and other distinctive qualities of each type of door hardware are indicated herein. Furnish items in types, sizes or weight, in accordance with manufacturer's standards, appropriate for the conditions of installation and service, unless otherwise indicated.

B. Products named or identified by make or model number, or other designation and described herein are base products. Base products establish the standards of type, in-service performance, physical properties, appearance, warranty, cost, and other characteristics required by the Project.

2.3 DOOR HARDWARE REQUIREMENTS AND GUIDELINES

A. Door hardware shall meet and conform to the following requirements (items listed in order of door scheduling sequence):

	HARDWARE ITEM	**ANSI/BHMA REQUIREMENT(S)**
1.	Materials and Finishes: *(See Section 2.4)*	ANSI/BHMA A156.18
2.	Butts and Hinges (e.g., sizes, templates):	A156.1, A156.7
3.	Continuous Hinges (e.g., geared, pinned):	A156.26
4.	Cylinders and Input Devices for Locks:	A156.5
5.	Mechanical Keying Systems:	A156.28
6.	Mortise Locks:	A156.13 (Grade 1)
7.	Auxiliary Locks (e.g., deadbolts):	A156.36
8.	Electrified Locks (hard-wired):	A156.25 (Grade 1)
9.	Exit Devices and Accessories:	A156.3 (Grade 1)

10.	Electrified Exit Devices:	A156.25, UL 305
11.	Panic Exit Devices:	UL305
12.	Fire Exit Devices and Mullions:	NFPA 80, UL305, NFPA 252
13.	Electric Strikes:	A156.31 (Grade 1), UL 1034
14.	Automatic / Manual Flush Bolts:	A156.3 / A156.16
15.	Auxiliary Hardware (e.g., door stops, dust proof strikes, silencers):	A156.16
16.	Door Coordinators:	A156.3
17.	Surface Door Closers:	A156.4 (Grade 1)
18.	Overhead Stops and Holders:	A156.8
19.	Power Assist & Low Energy Power Operators (incl. safety sensors, features):	A156.19; A156.31
20.	Actuators (frame-mounted):	A156.31
21.	Release Devices: Closer Holders, Electromagnetic and Electromechanical.	A156.15
22.	Architectural Door Trim: (e.g., protection, edging, astragals)	A156.6 (UL labeled as scheduled)
23.	Gasketing and Edge Seal Systems (e.g., astragals, perimeter seals, door bottoms, weatherstripping):	A156.22
24.	Thresholds:	A156.21
25.	Electrical Power Transfers, Door Position Switches:	(listed and labeled by testing agency acceptable to authorities having jurisdiction.
26.	Power Supplies:	UL listed, Class 1 and 2 outputs.

B. FASTENERS:

1. Provide concealed fasteners for hardware items on exterior doors which are exposed when door is closed.
2. Combination machine screws and expansion shields shall be used for attaching hardware to concrete or masonry.
3. Fasteners exposed to the weather in the finished work shall be of brass, bronze, or stainless steel.

C. BUTT HINGES:

1. Base Metal shall be steel plated for fire-rated doors; bronze or stainless steel for exterior out-swinging doors; bronze or plated steel elsewhere as scheduled.
2. Provide hinges with antifriction bearings for doors with closers.
3. Provide hinge weights/ gauges for doors as follows:
   a. Doors to 1-3/4” thick and 36” wide: Standard Weight.

b. Doors over 36” wide: Heavy Weight

c. Doors over 1-3/4” thick: Heavy Weight.

4. Unless otherwise indicated, provide hinges in heights as follows:

a. Doors over 1-3/4” thick shall be per hinge manufacturers published listings and recommendations, and as follows:

b. Doors to 36” wide: 4-1/2”.

c. Doors over 36” to 48” wide: 5”.

d. Doors over 48” wide: 6”.

5. Provide in minimum width sufficient to clear trim when door swings 180 degrees, whether or not shown on Drawings to swing 180 degrees.

6. Number of hinges per leaf shall be as follows:

a. Doors up to 60” in height: 2 hinges

b. Doors over 60” to 90” in height: 3 hinges

c. Doors over 90” to 120” in height = 4 hinges

d. For doors over 120” in height: 4 hinges plus 1 hinge for every 30”, or fraction thereof, door height greater than 120”.

7. Screws: Flat head wood screws not less than 1-1/2” long for hinges for wood doors; flat head machine screws elsewhere.

8. Hinges for reverse bevel doors with locks shall have pins that are made non-removable when the door is in the closed position by means of a set screw in the hinge pin barrel.

9. Electrified hinges:

a. Coordinate number and size of wires for electrified hardware served.

b. Provide junction box/ mortar shield for each electrified hinge.

D. CONTINUOUS GEARED HINGES:

1. Type: Heavy duty assembly of 3 interlocking aluminum extrusions. Door leaf and jamb leaf shall be continuously geared together the full hinge length; secured together with full length cover channel permitting 180 degree operation. Vertical door loads carried on integrated thrust bearings spaced no more than 3” apart.

2. Hinges shall have non-removable cap at hinge top to prevent foreign material from becoming lodged in hinge gear mechanism.

3. Unless otherwise noted, provide factory finished to match door and frame finish.

4. Hole pattern for fasteners shall be symmetrical and located to template dimensions.

E. CONCEALED HINGES

1. A. Concealed Hinges: Hinges mortised into door and frame so that they are concealed when the door is closed.

2. Hinges shall be adjustable three ways:

a. Vertically

b. Horizontally

c. Compression (in/out) (i.e., capable of a 180-degree swing).

3. Hinges are to be non-handed.
4. Provide fastener type, size, and quantity as recommended by hinge manufacturer for properly installing concealed hinges in the door and frame type application.
5. Provide steel receiver for metal door and frame cutouts for receiving concealed hinges.

F. CYLINDERS, KEYING AND KEY STORAGE:

1. All cylinders shall be interchangeable core type, unless otherwise directed by Owner.
2. A new great grand master keying system shall be provided unless otherwise instructed by the Owner.
3. Cylinders shall be keyed according to approved Keying Schedule.
4. Provide a temporary keying system for interim use during construction.
5. Provide change keys in individual envelopes for each cylinder delivered. Envelopes shall be marked with respective door identification numbers.
6. Key set symbol, and inscription "Do Not Duplicate" shall be stamped on all keys.
7. Key set symbol shall be concealed stamped on all cylinders/ removable/ Interchangeable cores unless otherwise directed by the Owner.
8. Keys shall be supplied as follows:
   a. Locks: 3 change keys each lock.
   b. Master keyed sets: 2 keys each set.
   c. Grand master keys: 5 total.
   d. Great Grand master keys: 5 total.
   e. Interchangeable Core control keys: 2 total.
   f. Construction keys: 10 total.
   g. Blank keys: 100 total.
9. Provide Key Storage / Control System conforming to ANSI/BHMA A156.5, including key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers. Contain system in metal cabinet with baked-enamel finish and key locking door.
   a. Key tags and holders shall be inscribed with key-change number and key-control to conform with approved hardware schedule for identification.
   b. Key Storage System shall be large enough to accommodate 150 percent of the facility.
10. Subject to compliance with requirements, provide emergency entrance key vault(s); Knox Company 3200 Series, or equal.
    a. Finish Color - Black, Dark Bronze or Aluminum as selected by Architect.
    b. Where indicated provide security key override switches for electrically activated openings.
    c. Coordinate and provide keying and type per fire/police department, and other jurisdictional agency requirements.

G. LOCKSETS AND LATCHSETS:

1. Operating trim style(s) shall match across all latching hardware (unless specified otherwise); and shall be as follows:

MANUFACTURER	ROSE	LEVER	THUMB-TURN
Dorma	A	L118	ADA
Sargent Manuf.	LN	MD	130LB
Schlage	A	LAT	09-509

2. Provide Vandal Resistant Trim as directed by Owner.
3. Lock functions which include thumb turn trim shall be provided with thumb turns compliant with accessibility code requirements.
4. Lock Throw: Comply with requirements for length of latch bolts on single and pair of doors to comply with labeled fire door requirement.
5. Lock backset shall be 2-3/4" unless otherwise indicated.
6. Provide curved-lip strike with dust box for each latch or lock bolt, with lip extended to protect frame, finished to match door hardware set, unless otherwise indicated.
7. Electromechanical locksets utilized at fire-rated openings shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction and shall maintain door in positive latched position when power is off.

H. FLUSH BOLTS:

1. Bottom bolt shall have 12" long operating rod. Top bolt operating rod shall be determined by door height, assuring the operator is located less than 72" above the floor.
2. Manual Flush Bolts are not to be utilized except where a pair of non-rated doors serving a room not normally occupied is needed for the movement of equipment.

I. EXIT DEVICES:

1. Operating trim lever style(es) shall match across all latching hardware; unless specified otherwise. Lever style shall be as follows:

MANUFACTURER DOOR PULL	ESCUTCHEON		LEVER
Dorma	Y	L118	OP
Sargent Manuf.	ET	MD	862
Von Duprin	996	LAT	392-7

2. Provide Vandal Resistant Trim as directed by Owner.
3. Actuating portion of exit device bars shall extend across not less than one-half the width of the door leaf.
4. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
5. Adjustable strikes shall be provided for rim type and vertical rod devices.
6. Exit Devices at exterior and/or secured door openings shall be supplied without dogging.

7. Fire Exit Devices: Complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
8. Electromechanical exit devices utilized at fire-rated openings shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction, and shall maintain door(s) in positive latched position when power is off.

J. ELECTRIC STRIKES:

1. Electric strikes for fire-rated openings shall be listed and labeled for such use by a testing agency acceptable to authorities having jurisdiction. Fail Secure (fail locked) strikes shall be used at all fire-rated openings.

K. SURFACE DOOR CLOSERS:

1. Surface closers shall be fully adjustable with sweep speed, latch speed and back check position valves.
2. Provide closers size adjusted in accordance with ANSI/BHMA A156.4; sized as required to ensure closing and latching of doors.
3. Arm selection shall follow the requirements of the manufacturer's recommendations with brackets, drop plates and miscellaneous accessories provided as necessary.
4. Provide closers with arms designed to permit openings of doors as far as job conditions will permit; unless otherwise indicated closers with arms restricting opening of door will not be acceptable.
5. Provide heavy-duty dead stop arm closers when door closer is on the push/ parallel arm side of the door and if conditions do not permit installation of floor or wall stop per PART 2, Auxiliary Hardware and PART 3, Door Closing Devices.
6. Provide opening force as required per Specification PART 1, Regulatory Requirements.

L. DOOR COORDINATORS:

1. Door coordinator mounting brackets to accommodate required hardware.
2. Provide carry bar at each pair of doors equipped with an overlapping astragal, except when automatic or self-latching bolts are used.

M. OVERHEAD HOLDERS AND STOPS:

1. Overhead door holders and stops shall be adjustable from 90 to 110 degrees dead stop or hold open position, as applicable.
2. Overhead door stops shall have shock absorbers providing 5 to 7 degrees compression before dead stop.
3. Overhead stops shall not be provided with hold open function when used at fire-rated doors.

N. AUTOMATIC AND LOW ENERGY DOOR OPERATORS:

1. Surface Applied Operator: The operator header shall be mounted to the surface of the door frame or wall. Connecting hardware shall be a double arm arrangement that can either push the door or pull the door open to suit the job condition. Provide parallel arm when operator mounting is on the pull side, and adjacent wall is within 4” of the door frame. Provide fire labeled unit for use at rated doors.

2. Overhead Concealed Operator: The operator header shall be mounted directly over the door and serve as the door frame header. The operator output shaft shall connect to an arm that transmits power to the door via a slide block which moves in track that is recess mounted in the top of the door.
3. In-Floor Operator Converter: Manufacturer's specialized unit to adapt specified automatic swing door operator to in-floor use. The converter shall be mounted beneath the door leaf and jamb area utilizing a standard pivot setback. Heavy-duty pivot shall incorporate 1200 pound rated, sealed thrust bearings in 1" steel bearing plate.
4. Automatic Operators to be installed and field adjusted by an AAADM Certified Professional.
5. Power operation shall be activated by actuator or sensor as scheduled.
    a. Actuators shall be wall-mounted and labeled with "Push to Open", unless noted otherwise.
6. Operation and Functionality:
    a. Door shall not open to back check faster than 3 seconds, and shall require no more than 15 lbf applied 1" from latch edge to stop door movement.
    b. Door shall remain in fully open position for no less than 5 seconds (6 per MAAB).
    c. Door shall close from 90 degrees to 10 degrees no faster than 3 seconds, and 10 degrees to fully close no faster than 1-1/2 seconds (or from 90 degrees to fully closed is 6 seconds, per MAAB).
    d. Power operation shall be activated by push plate switch, or other actuators as indicated.
7. Provide UL labeled operators at fire-rated openings. Provide power-disconnect interface to Fire Alarm; doors to be self-closing and latching, in full compliance with Code requirements for "Fire Assembly, Self-Closing" doors.
8. Provide UL labeled operators at smoke barrier openings. Provide hold-open circuitry and power-disconnect interface to Fire Alarm; doors to be automatic closing and latching, in full compliance with Code requirements for "Fire Assembly, Automatic Closing" doors.
9. Provide opening force as required per Specification PART 1, Regulatory Requirements.
10. Control Features
    a. Power-hold Close
    b. Built in Lock Delay
    c. On-Off-Hold Open switch control to control door function, (Automatic-Hold Open- Exit Only)
    d. On-Off Power Switch
    e. Fire Alarm Integration
    f. Field Adjustable Handing
    g. Push and Go
    h. Power Assist Opening Activation
    i. Intergraded Connections for Monitored Safety Sensors and other accessories.

j. Integrated access control

11. Door Control Features
    a. Wind Load and Stack Pressure microprocessor monitored with power boost to ensure secure opening and closing in changing conditions.
    b. Door Weight Max. ED 250 - 600 lbs.
12. Header Size: Fine header height at 2 ¾" by 5" 1/8" depth.
13. Safety Devices
    a. Provide door controls in accordance with ANSI/BHMA standards A 156.19 and complying with cited BHMA standard for condition of exposure and for long-term, maintenance-free operation under normal traffic load. When presence sensors are used, they shall be monitored in accordance with ANSI/BHMA A 156.10. Coordinate controls with door operation and door operators.
    b. Adaptive Door Mounted Sensor System (Basis of Design):
        1) Adaptive Door Mounted Safety Systems (ADMSS): Door mounted presence sensor, where the sensor shall be mounted on both the swing (pull) side and the approach (push) side of the door. No header mounted sensor is required.
        2) The sensor shall provide a full detection pattern that covers the entire swing path of the door and provides detection in the fully open and full close position. While the door is in motion, the pattern shall be capable of providing door panels from 24" to 48"
        3) The sensor will provide secondary activation as required for "knowing act" doorways.
        4) Sensors to be field installed and adjusted in accordance with applicable safety standards.
    c. System will reactivate a closing door, stop/stall an opening door, keep a closed door closed and keep an open-door open if a person is within the detection zone of the sensors.
14. Electrical
    a. Electrical 115 V AC +/- 10% 50/60 Hz 6.6 A max.
15. Bollards to meet basis-of-design products specified, fabricated from 7 gauge formed stainless steel per metal finish specified, with welded flat top, cutouts and hood/flange for electrified devices, surface/concealed base plate with standard mounting bolts, coordinated with ground material to prevent water infiltration. Refer to Architectural Drawings for more locations and details.

O. ELECTROMAGNETIC HOLDERS/RELEASES:
1. Size and configuration shall provide degree of swing and hold open position as indicated on the drawings.

P. ARCHITECTURAL DOOR TRIM:
1. Door Protection Plates: Kick, mop, and armor plates shall be 0.050” thick brass, bronze, or stainless steel depending on finish indicated. Plates shall have beveled edges and shall be provided with countersunk mounting holes and No. 6 oval head screw fasteners.
    a. Width of kick and armor plates shall be 2” less than door width for single doors and 1” less for pairs of doors.

b. Width of mop plates shall be 1” less than door width.

c. Unless otherwise indicated, height shall be 10” for kick and mop plates, and 34” for armor plates.

d. When door protection items are not indicated in Hardware Sets, then refer to Door Schedule and/or Drawings for required locations.

e. At fire-rated doors, provide UL labeled protection plates in sizes, types, fasteners and materials only in accordance with door manufacturer's listings for respective ratings.

2. Door Edging and Astragals: Fabricated from 18 gauge cold-rolled steel or 304 stainless steel as indicated; factory prepared for all mortise hardware; countersunk screw mounting.

a. At fire-rated doors, provide UL labeled edge protection in sizes, types, fasteners and materials only in accordance with door manufacturer's listings for respective ratings.

3. Push and pull plates shall be 0.050” thick brass, bronze, or stainless steel depending on finish indicated.

a. Plates shall have beveled edges, and shall be furnished with countersunk mounting holes and No. 6 oval head screw fasteners.

b. Pull plates shall also be furnished with flat-head through bolts for pull grip.

4. Push and pull bars and grip handles shall be brass, bronze, or stainless steel depending on BHMA finish indicated.

5. If architectural door trim is not scheduled in the hardware sets; then refer to Architectural Drawings and/or Door Schedule for required locations.

Q. AUXILIARY HARDWARE:

1. Door Stops: Stops shall be of heavy-duty construction, provided in finish indicated. Wall bumpers shall have no visible fasteners. Floor stops shall be of height required by floor conditions. Unless otherwise indicated, provide stops at all doors as follows:

a. Supplier shall only provide one Door Stop per door leaf. When multiple options are specified, the preferred type shall be supplied *in lieu of* any others.

b. At exterior, out-swinging doors provide overhead stop or heavy-duty stop function on door closer arm. At all other doors provide wall bumpers if conditions permit, or otherwise floor stops. Where it is not possible to properly place a floor stop due to tripping hazard or any other condition, or wall type stop due to device on door not striking wall or any other condition, provide heavy duty concealed overhead type stop, or heavy-duty stop dead stop arm in door closer when door closer when installed parallel arm/ push side of door per Specification PART 3, Door Closing Devices.

2. Silencers: Gray rubber, non-marring configured for metal or wood frames as scheduled. Provide 3 per single door and 2 per pair of doors.

a. Silencers shall be tamper resistant once installed in door frame.

b. Silencers may be omitted at openings where door frames are provided with integral seals if integral seals satisfy all applicable Codes and Regulations.

R. DOOR BOTTOMS:

1. Door bottoms shall be of aluminum or extruded bronze of the type and finish indicated and shall provide proper clearance and an effective seal with specified thresholds.
2. Door bottom shall have a vinyl, neoprene, silicone rubber, polyurethane or brush seal as indicated.
3. The door bottom shall exclude light when the door is in the closed position and shall inhibit the flow of air through the unit.
4. Coordinate door bottom/sweep with full width of door leaf, perimeter gasketing, pivots, continuous hinges, and any other door hardware occupying the same space.

S. METAL THRESHOLDS:

1. Thresholds shall be heavy-gauge aluminum or bronze of the configuration and finish indicated, and shall provide an effective seal with door bottom.
2. Where required, thresholds shall be prepared to accommodate floor closers, pivots, and projecting bolts of latching hardware.
3. Thresholds at floor closers shall have mitered returns and removable access portion for floor closer maintenance.
4. Provide thresholds at doors where indicated. Refer to Door Schedule and Drawing details for type and configuration required. Additionally, where combustible flooring passes under doors, provide fire door thresholds in accordance with applicable regulatory requirements.

T. METAL HOUSED TYPE WEATHERSTRIPPING:

1. Metal Housed Type Weatherstripping shall be aluminum or bronze of the type and finish indicated, comprised of metal retainers with vinyl, neoprene, silicone rubber, polyurethane or brush inserts as indicated.

U. GASKETING:

1. Shall be a compression type product for use with wood or steel doors; labeled for use on smoke-control and fire-rated doors where required.
2. Gasketing may be omitted at openings where door frames are provided with integral seals if integral seals satisfy all applicable Codes and Regulations.

V. ELECTRICAL POWER TRANSFERS:

1. Electrical power transfers shall be capable of transferring sufficient electrical current to properly operate electrified hardware in door.
2. Electrical power transfers used on fire-rated doors shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

W. DOOR POSITION SWITCHES:

1. Door position switches used on fire-rated doors shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
2. Security Drawings and Specifications (Section #280000) supersede this specification for locations of all Electronic Access Control components, accessories, and wiring.

X. POWER SUPPLIES FOR ELECTRIFIED HARDWARE:

1. Output shall be filtered and regulated. Relay, timer, and logic modules shall be provided as required for interface to related security components; and shall be assembled, connected, and fully contained within the power supply enclosure. A fire alarm emergency release input terminal shall be provided for connection to fire / life safety system at fire-rated openings.
2. Power supplies shall provide sufficient power capacity for the worst-case condition that could occur in the operating environment without any loss or degradation of operation.

2.4 FINISHES

A. Metal finish(es) shall match at each door opening as scheduled; unless specified otherwise.

B. Comply with base material and finish requirements indicated by the following:

BHMA	U.S.	DESCRIPTION	BASE MATERIAL
(612)	US10	Satin Bronze, Clear Coated	Bronze
(626)	US26D	Satin Chromium Plated	Brass, Bronze
(630)	US32D	Satin Stainless Steel (300 Series)	Stainless Steel
(639)	US10	Satin Bronze Plated, Clear Coated	Steel
(689)	SP28	Aluminum Painted	Brass
(691)	SP10	Light Bronze Painted	Brass
(716)		Satin Bronze Plated, Clear Coated	Steel
(719)		Mill Finish Aluminum, Uncoated	Aluminum
(BLK)		Black Color (Match EACH Frame's Finish)	Polymer
(CLR)		Clear (Match EACH Frame's Finish)	Polymer
(DRK)		Dark Brown (Match EACH Frame's Finish)	Polymer
(GRY)		Gray Color (Match EACH Frame's Finish)	Polymer
(TAN)		Tan Color (Match EACH Frame's Finish)	Polymer

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine doors and frames for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine rough-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Steel doors shall be factory prepared for hardware per ANSI/BHMA A156.115.

B. Wood doors shall be factory prepared for hardware per ANSI/BHMA A156.115W.

C. Installation shall be in accordance with DHI A115.IG.

D. Hardware for fire door assemblies shall be installed conforming with NFPA 80, and all other applicable building codes and regulations.

E. Hardware for smoke door assemblies shall be installed conforming with NFPA 105, and all other applicable building codes and regulations.

F. Install each door hardware item according to manufacturer's printed instructions, utilizing templates and proper fasteners provided by manufacturer.

G. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

H. 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 other Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

3.3 PUSH-PULL PLATES

A. Pull plate grip handles shall be through bolted through the door. When push plate is indicated on opposite door side, through bolts shall be countersunk with push plate mounted to conceal through bolts.

3.4 KEY CONTROL STORAGE SYSTEMS

A. Key control storage system shall be installed where directed by the Owner.

B. Place keys on markers and hooks in key control system cabinet, as determined by final keying schedule.

3.5 DOOR CLOSING DEVICES

A. Surface closers on doors opening to or from halls and corridors shall be mounted on the room side of the door.

B. Surface closers on doors opening into stairs or stair vestibules shall be mounted on the stair or stair vestibule side of the door.

C. Surface closers on exterior doors shall be mounted on the interior side of building utilizing regular arm, or parallel arm mounting as required.

D. Door closing devices with adjustable spring power shall be adjusted for proper door operation, and compliance with all applicable codes and regulations.

E. Cutting of gasketing or weatherstripping to accommodate closer installation is not acceptable.

3.6 ASTRAGALS

A. Unless otherwise indicated install overlapping astragals as follows:
   1. At out-swing pairs of doors, mount astragal on active leaf.
   2. At in-swing pairs of doors, mount astragal on inactive leaf.

3.7 THRESHOLDS

A. Thresholds shall be secured with a minimum of 3 fasteners per single door width and 6 fasteners per double door width with a maximum spacing of 12”; with a minimum of 1” thread engagement into the floor or anchoring device used. Thresholds over 6” in width shall be secured with a double row of fasteners.

B. Exterior thresholds shall be installed in a bed of sealant with combination expansion anchors and stainless-steel machine screws, except that bronze or anodized bronze thresholds shall be installed with expansion anchors with brass screws.

3.8 HARDWARE LOCATIONS

A. Unless otherwise indicated install hardware as follows:

	COMPONENT(S)	REQUIRED MEASUREMENT(S)
1.	Bottom Hinge:	10” from door bottom to bottom of hinge.
2.	Top Hinge:	5” from door top to top of hinge.
3.	Center Hinge(s) or Pivot(s):	Spaced equidistantly between top and bottom hinges/ pivots.
4.	Lockset / Latchset:	38” from finished floor to center of lever.
5.	Exit Device:	38” from finished floor to device centerline.
6.	Deadlock:	32” from finished floor to center key cylinder / thumb turn.
7.	Push Plate/ Pull Plate:	42” from finished floor to center of pull.
8.	Wall Bumper:	Centered at point on wall where lever, or other operating trim, first makes contact with wall.
9.	Floor Stop:	Adjacent to wall; not to exceed 4” from face of wall; located 3” from latch edge of door; in any case never more than 50 percent of door width from latch edge of door.

3.9 ADJUSTING

A. 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.

B. Engage a factory-authorized service representative to adjust door closing devices, compensating for final operation of heating and ventilating equipment, and to comply with referenced accessibility requirements.

C. Follow-up Adjustment: Approximately 6 months after date of Substantial Completion, Installer shall perform the following:

1. Examine and readjust each item of door hardware as necessary to ensure function of door hardware.
2. Consult with and instruct Owner's personnel on recommended maintenance procedures.
3. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

D. Adjust door closers, operators, and controls for smooth and safe operation.

3.10 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant:

1. Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
2. Independent Architectural Hardware Consultant shall inspect door hardware and prepare written report whether installed work complies with or deviates from requirements, whether door hardware is properly installed and adjusted, and prepare a specific list of any deficiencies, a copy of which shall be provided to Architect.
3. Contractor shall correct all deficiencies noted in above report.
4. Independent Architectural Hardware Consultant shall re-inspect door hardware and prepare a report certifying correction of deficiencies and compliance with requirements.

3.11 COMPLETION

A. When complete all hardware shall be properly secured in place and all exposed surfaces shall be clean and free from scratches, paint, and other defects and damages.

B. Contractor shall demonstrate that all keys properly operate the locks as identified in the approved Keying Schedule.

3.12 DOOR HARDWARE SETS

A. Door Hardware Sets are a general listing of hardware requirements. The Contactor and Door Hardware Supplier are required to convert these condensed citations into complete and current manufacturer product numbers; and are also required to supply hardware items that are required by established standards and practices to meet state and local codes, even if not cited herein.

B. Hardware Set Line Items are “basis-of-design” products, per Owner Facility Standards and/or Architect Aesthetic Preferences. Refer to Part 2 for approved equal manufacturers.

C. Refer to Architectural Drawings for “Door Schedule”, which supersedes ALL citations and descriptions specified herein; especially Hardware Sets assigned to each Door Number (including “Suffixes” from the “Hardware Set Numbering Legend” below, if applicable).

D. Hardware Sets may exclude Lever Styles and/or Metal Finishes, which are specified above in Part 2.3 and Part 2.4, respectively.

E. Contractor and/or Door Hardware Supplier to coordinate ( ) “metal finish” and/or “color” (e.g., white, tan, gray, black, etc.) of Door Trim, Gasketing, and Accessories. These finishes are intentionally omitted from the hardware sets due to further/future field coordination required with finishes for doors, frames, walls, and floors.

F. Operational Narratives are specified for coordination and educational purposes only. Requirements conveyed in Security Drawings, Door Elevations, and/or Riser Diagrams (by Others) shall supersede all Electrified hardware ( ) and descriptions specified herein.

HARDWARE SET NUMBERING LEGEND

SUFFIX	DESCRIPTION	
• ___ **No**	SATIN CHROME (e.g., 626, 630, 689, 719, GRY)	*…Refer to Spec Section 2.4*
• ___**.1**	SATIN BRONZE (e.g., 612, 639, 691, 716, TAN)	*…Refer to Spec Section 2.4*

MANUFACTURER'S ABBREVIATIONS *~ parent company/group*

**hyperlinks to websites embedded below*

ALC	Alarm Controls	*~ assa abloy*
BEA	BEA Sensors	*~ halma*
CRL	CR Laurence	
DOR	Dorma	*~ dormakaba*
MCK	McKinney	*~ assa abloy architectural door accessories*
PEM	Pemko	*~ assa abloy architectural door accessories*
RIX	Rixson Door Controls	*~ assa abloy*
ROC	Rockwood Manufacturing	*~ assa abloy architectural door accessories*
SAR	Sargent Manufacturing	*~ assa abloy*
SEC	Securitron	*~ assa abloy electronic security hardware*
SOS	SOSS Door Hardware	
VON	Von Duprin	*~ allegion*

ANNOTATIONS LEGEND		***Specified and Supplied under Specification Section:***
⚠	**Special/Vital Note**	***(Pertinent to ALL Spec Sections)***
	Coordinate as Noted	*(087100) "Door Hardware"*
	Mechanical Key	*(087100) "Door Hardware"*
	Key Storage (cabinet)	*(087100) "Door Hardware"*
	Electric (wired)	*(087100) "Door Hardware"*
	Tied to Fire Alarm	*(087100) "Door Hardware"*
	Automatic Opening	*(087100) "Door Hardware"*
	Items by Others	*(081123) "Bronze Doors and Frames"*
		(102213) "Wire Mesh Partitions"
		(323100) "Fences and Gates"
	Wiring Harness(es)	*(280000) "Electronic Safety and Security"*

HARDWARE SET 1.1

*Exterior Bronze **Pair** ~ Egress, Automatic, Secured, Remote Activation*

Location: Lobby

		Pivots (offset, quantity as required)	*by Door Assembly Manufacturer*	
	2	Door Pull (straight)	RM302 (1 ¼" ∅, 18" length, beneath keyway)	ROC
	1	Exit Device (tubular)	PA-100 (less door pull, secondary leaf)	CRL
	1	Exit Device (tubular, keyed)	PA-100 (less door pull, primary leaf)	CRL
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Electric Strike (overhead, double)	ESP2 (bolt sensors, fail secure)	CRL
	1	Automatic Operator (active door leaf)	ED250-FC (narrow profile, full power)	DOR
	2	Touchless Actuator (narrow size)	10MS31J	BEA
	1	Door Closer (secondary door leaf)	TS93 (low profile, coord. w/glass)	DOR
	2	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	2	Astragal / Gasketing (integral)	*by Door Assembly Manufacturer*	
	1	Weatherstripping (integral)	*by Door Assembly Manufacturer*	
	1	Perimeter Seals (head/jambs)	*by Door Assembly Manufacturer*	
	1	Threshold (thermal)	*by Door Assembly Manufacturer*	
	1	Request to Exit (motion sensor)	SREX-100 (narrow activation zone)	ALC
	2	Door Position Switch (per door leaf)	*by Security Vendor*	
	1	Card Reader (narrow size)	*by Security Vendor*	
	1	Intercom (outside)	*by Security Vendor*	
		Power Supply (as needed)	*by Security Vendor*	
		Wiring Harness (as needed)	*by Security Vendor*	

NOTE : Balance of door hardware by door assembly manufacturer.

NOTE : Automatic Operator must be installed and field adjusted by AAADM Certified Professional.

OPERATIONAL NARRATIVE:

- *STATUS:*
  - *Doors normally closed (Auto Operator, Door Closer), latched (Exit Device), and secured (Electric Strike); unless programmed/scheduled unlocked via Access Control System.*
  - *Electric Strike built-in bolt sensors monitor door positions.*
  - *Upon reclosure of doors, conditions return to normal status.*
  - *Upon loss of power, Electric Strike remains locked (fail secure), preventing ingress.*
- *INGRESS:*
  - *Authorized credential to Card Reader (outside) momentarily unlocks Electric Strike and shunts bolt sensors, allowing manual ingress (either door leaf).*
  - *Authorized credential to Card Reader then motion detected by Touchless Actuator (outside), momentarily unlocks Electric Strike and shunts bolt sensor; then activates Automatic Operator, allowing accessible ingress (primary door leaf).*

- *Key override unlocks Exit Device (by authorized personnel or emergency responders only), bypasses access control, allowing emergency ingress (primary door leaf).*

- *EGRESS:*
  - *Motion detected by Touchless Actuator (inside) momentarily unlocks Electric Strike and shunts bolt sensor; then activates Automatic Operator, allowing accessible egress (primary door leaf).*
  - *Request to Exit detects motion (within narrow activation zone) and shunts alarm upon egress.*
  - *Exit Device pushbar always allows manual egress (either door leaf).*

HARDWARE SET 2.1

*Exterior Metal / Glass **Pair** ~ Egress, Secured*

Location: Multipurpose Room

	2	Hinge (continuous)	_FM-HD (match door/frame finish)	PEM
	1	Exit Device (conc. rods, primary)	PA-QEL-9847-LNL-FSE (key override)	VON
	1	Exit Device (conc. rods, secondary)	PA-QEL-9847-LDT-FSE	VON
	1	Cylinder / Core (key override)	*per Owner / Facility Key System*	
	2	Door Closer (inside, high traffic)	8900 T / SPA (FC)	DOR
	2	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Protection Plate (kick, push side)	K1050-CSK (10" high)	ROC
	2	Door Bottom (rain drip)	215_PK / 2221_PK	PEM
	1	Astragal Set (split)	351_PK (match door finish/color)	PEM
	2	Weatherstrip (adjustable, jambs)	379_PK	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (thermal, as required)	2705_T (per sill conditions)	PEM
	1	Request to Exit (motion sensor)	SREX-100 (narrow activation zone)	ALC
	2	Door Position Switch (per door leaf)	*by Security Vendor*	
	1	Card Reader (narrow size)	*by Security Vendor*	
		Power Supply (as needed)	*by Security Vendor*	
		Wiring Harness (as needed)	*by Security Vendor*	

OPERATIONAL NARRATIVE:

- *STATUS:*
  - *Door normally closed (Door Closer), latched and secured (Electric Exit Device).*
  - *Door Position Switch monitors door position.*
  - *Upon reclosure of door, conditions return to normal status.*
  - *Upon loss of power, Exit Device remains locked (fail secure), preventing ingress.*
- *INGRESS:*
  - *Authorized credential to Card Reader (outside) momentarily unlocks Electric Exit Device and shunts built-in door position switch, allowing manual ingress.*
  - *Key override to Electric Exit Device (by authorized personnel or emergency responders only) bypasses access control, allowing emergency ingress.*

- *EGRESS:*
  - *Electric Exit Device pushbar (inside) built-in request to exit switch shunts Door Position Switch, and always allows egress.*

HARDWARE SET 3.1

Exterior Metal ~ Egress, Secured

Location(s): Corridor / Exterior

	1	Electrified Hinge (continuous)	_FM-HD-SER	PEM
	1	Electric Exit Device (rim, fail secure)	RX-QEL-PA-98-LNL (latch retraction)	VON
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Door Closer (inside, high traffic)	8900 T / SPA (FC)	DOR
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Protection Plate (kick, push side)	K1050-CSK (10" high)	ROC
	1	Door Bottom (rain drip)	215_PK / 2221_PK	PEM
	2	Weatherstrip (adjustable, jambs)	379_PK	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (thermal, as required)	2705_T (per sill conditions)	PEM
	1	Door Top Weatherstrip (if required)	346 (match outside frame color)	PEM
	1	Door Position Switch (per door leaf)	*by Security Vendor*	
	1	Card Reader (narrow size)	*by Security Vendor*	
		Power Supply (as needed)	*by Security Vendor*	
		Wiring Harness (as needed)	*by Security Vendor*	

OPERATIONAL NARRATIVE:

- *STATUS:*
  - *Door normally closed (Door Closer), latched and secured (Electric Exit Device).*
  - *Door Position Switch monitors door position.*
  - *Upon reclosure of door, conditions return to normal status.*
  - *Upon loss of power, Exit Device remains locked (fail secure), preventing ingress.*
- *INGRESS:*
  - *Authorized credential to Card Reader (outside) momentarily unlocks Electric Exit Device and shunts built-in door position switch, allowing manual ingress.*
  - *Key override to Electric Exit Device (by authorized personnel or emergency responders only) bypasses access control, allowing emergency ingress.*
- *EGRESS:*
  - *Electric Exit Device pushbar (inside) built-in request to exit switch shunts Door Position Switch, and always allows egress.*

HARDWARE SET 4.1

Exterior Metal ~ Egress, Monitored

Location(s): Corridor / Exterior

	1	Hinge (continuous)	_FM-HD	PEM
	1	Exit Device (rim, night-latch)	PA-98-NLOP	VON
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Door Closer (inside, high traffic)	8900 T / SPA (FC)	DOR
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Protection Plate (kick, push side)	K1050-CSK (10" high)	ROC
	1	Door Bottom (rain drip)	215_PK / 2221_PK	PEM
	2	Weatherstrip (adjustable, jambs)	379_PK	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (thermal, as required)	2705_T (per sill conditions)	PEM
	1	Door Top Weatherstrip (if required)	346 (match outside frame color)	PEM
	1	Request to Exit (motion sensor)	SREX-100 (narrow activation zone)	ALC
	2	Door Position Switch (per door leaf)	*by Security Vendor*	

NOTE : Motion detected by Request to Exit (within narrow activation zone) shunts Door Position Switches upon egress.

HARDWARE SET 5.1

Exterior Metal ~ Locked, Monitored

Location(s): Service Catwalk, Storage

	1	Hinge (continuous)	_FM-HD	PEM
	1	Lock (mortise, storeroom)	8204	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Door Closer (inside, high traffic)	8900 T / SPA (FC)	DOR
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Protection Plate (kick, push side)	K1050-CSK (10" high)	ROC
	1	Door Bottom (rain drip)	215_PK / 2221_PK	PEM
	2	Weatherstrip (adjustable, jambs)	379_PK	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (thermal, as required)	2705_T (per sill conditions)	PEM
	1	Door Top Weatherstrip (if required)	346 (match outside frame color)	PEM
	1	Door Position Switch (per door leaf)	*by Security Vendor*	

NOTE: Roof Egress Doors to be keyed inside, always allowing free egress from rooftop/exterior.

HARDWARE SET 6

*Metal / Glass **Pair** ~ Egress, Lockable, Hold Open*

Location: Gymnasium, Multipurpose

	2	Hinge (continuous)	_FM-HD (match door/frame finish)	PEM
	2	Exit Device (conc. rods, lockable)	PA-9847-L	VON
	2	Cylinder / Core	*per Owner / Facility Key System*	
	2	Door Closer (inside, high traffic)	8900 T / SPA (FC, 180° as required)	DOR
	2	Electromechanical (EM) Holder	997M / 998M (coord. w/lever/closer)	RIX
	2	Door Stop (wall-mounted)	400	ROC
	2	Protection Plate (kick, push side)	K1050-CSK (10” high)	ROC
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 7

Metal / Glass ~ Egress, Lockable

Location: Gymnasium

		Hinge (hvy-duty, qty/size as req’d)	T4A3386 (1NRP@outswing)	MCK
	1	Exit Device (rim)	PA-98-L	VON
	1	Cylinder / Core (key override)	*per Owner / Facility Key System*	
	1	Door Closer (inside, high traffic)	8900 T / SPA (FC, 180° as required)	DOR
	1	Door Stop (wall-mounted)	400	ROC
	1	Protection Plate (kick, push side)	K1050-CSK (10” high)	ROC
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 8

*Exterior Metal **Pair** ~ Locked*

Location(s): Mechanical Room

		Hinge (hvy-duty, qty/size as req'd)	T4A3386 (1NRP@outswing)	MCK
	1	Lock (mortise, storeroom, active)	8204 (keyway faces indoors)	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Flush Bolt Set (manual, inactive leaf)	2845 / 2945	ROC
	1	Dust Proof Strike (inactive door leaf)	570 (match floor finish)	ROC
	2	Door Closer (inside, med. traffic)	8600 T / SPA (FC) (only if required)	DOR
	2	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Door Bottom (automatic, underneath)	411_PKL / 420_PKL	PEM
	1	Door Bottom (rain drip)	3452_PK (match door finish/color)	PEM
	2	Weatherstrip (adjustable, jambs)	379_PK	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (thermal, as required)	2705_T (per sill conditions)	PEM

HARDWARE SET 9.1

*Exterior Metal / Glass **Pair** ~ Egress, Locked, Monitored*

Location: Rear Corridor

	2	Hinge (continuous)	_FM-HD (match door/frame finish)	PEM
	1	Exit Device (conc. rods, primary)	PA-9847-LNL (night latch)	VON
	1	Exit Device (conc. rods, secondary)	PA-9847-EO (exit only)	VON
	1	Cylinder / Core	*per Owner / Facility Key System*	
	2	Door Closer (inside, high traffic)	8900 T / SPA (FC)	DOR
	2	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Protection Plate (kick, push side)	K1050-CSK (10" high)	ROC
	2	Door Bottom (rain drip)	215_PK / 2221_PK	PEM
	1	Astragal Set (split)	351_PK (match door finish/color)	PEM
	2	Weatherstrip (adjustable, jambs)	379_PK	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (thermal, as required)	2705_T (per sill conditions)	PEM
	1	Request to Exit (motion sensor)	SREX-100 (narrow activation zone)	ALC
	2	Door Position Switch (per door leaf)	*by Security Vendor*	

NOTE : Motion detected by Request to Exit (within narrow activation zone) shunts Door Position Switches upon egress.

HARDWARE SET 10

Metal / Wood ~ Push / Pull, Secured

Location(s): Zoom

		Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
☼	1	Electric Lock (mortise, fail secure)	NAC-82271 (key override, request to exit)	SAR
	1	Door Closer (low profile, inside)	TS93 (coordinate w/glass)	DOR
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Door Stop (wall-mounted)	400	ROC
	1	Door Bottom (automatic, underneath)	411_PKL / 420_PKL	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM
	1	Card Reader (narrow size)	*by Security Vendor*	
		Power Supply (as needed)	*by Security Vendor*	
		Wiring Harness (as needed)	*by Security Vendor*	

OPERATIONAL NARRATIVE:

- *STATUS:*
  - *Door normally closed (Door Closer), latched and secured (Electric Lock).*
  - *Electric Lock built-in door position switch monitors door position.*
  - *Upon reclosure of door, conditions return to normal status.*
  - *Upon loss of power, Electric Lock remains locked (fail secure), preventing ingress.*
- *INGRESS:*
  - *Authorized credential to Card Reader (outside) momentarily unlocks Electric Lock and shunts built-in door position switch, allowing manual ingress.*
  - *Key override to Electric Lock (by authorized personnel or emergency responders only) bypasses access control, allowing emergency ingress.*
- *EGRESS:*
  - *Electric Lock lever (inside) built-in request to exit switch, shunts built-in door position switch; and always allows egress.*

HARDWARE SET 11

*Metal / Wood **Pair** ~ Hidden, Lockable, Latching*

Location(s): Multipurpose Storage

		Hinge (concealed, qty/size as req'd)	218 / 418	SOS
	1	Deadbolt (lockable)	4877 (match door finish/color)	SAR
	1	Cylinder Pull	90 (match door finish/color)	ROC
	1	Cylinder / Core	*per Owner / Facility Key System*	
	2	Roller Latch (overhead, heavy-duty)	592 (coord. w/frame/header)	ROC
	2	Overhead Stop (hvy-duty, inside)	OH100S / OH900S	ROC
	2	Silencer (non-rated doors only)	608-RKW / 609 / 608CA (as req'd)	ROC
	1	Threshold (only if required)	2715_ / 2716_ (match floor finish)	PEM

NOTE: Deadbolt thumb-turn inside retracts bolt (but will not project it), as required for egress.

HARDWARE SET 12

Metal ~ Locked, Gasketing (odors)

Location(s): Janitor

		Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
	1	Lock (mortise, storeroom)	8204	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Door Closer (inside, med. traffic)	8600 T / SPA (FC)	DOR
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Protection Plate (kick, push side)	K1050-CSK (10" high)	ROC
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 13

Metal / Wood ~ Locked

Location(s): Mezzanine Mechanical, Storage

		Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
	1	Lock (mortise, storeroom, active)	8204 (keyway faces indoors)	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Door Closer (inside, med. traffic)	8600 T/SPA (FC) (180° as req'd)	DOR
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Door Stop (wall-mounted preferred)	400	ROC
	3	Silencer (non-rated doors only)	608-RKW / 609 / 608CA (as req'd)	ROC
	1	Threshold (only if required)	2715_ / 2716_ (match floor finish)	PEM

HARDWARE SET 14

*Metal / Wood **Pair** ~ Locked*

Location(s): Storage

		Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
	1	Lock (mortise, storeroom, active)	8204 (keyway faces indoors)	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Flush Bolt Set (manual, inactive leaf)	2845 / 2945	ROC
	1	Dust Proof Strike (inactive door leaf)	570 (match floor finish)	ROC
	2	Door Closer (inside, med. traffic)	8600 T/SPA (FC) (180° as req'd)	DOR
	2	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	2	Door Stop (wall-mounted preferred)	400	ROC
	2	Silencer (non-rated doors only)	608-RKW / 609 / 608CA (as req'd)	ROC
	1	Threshold (only if required)	2715_ / 2716_ (match floor finish)	PEM

HARDWARE SET 15

Metal ~ Lockable, Gasketing (noise)

Location(s): Computer Room, Kitchenette, Lounge

		Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
	1	Lock (mortise, classroom)	8237	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Door Stop (wall-mounted preferred)	400	ROC
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 16

Metal / Wood ~ Lockable, Gasketing (privacy)

Location(s): Rec. Manager

		Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
	1	Lock (mortise, office)	8256-130LB	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Door Stop (wall-mounted preferred)	400	ROC
	1	Door Bottom (acoustic)	234_PK / 222_PK	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 17

Metal / Wood ~ Locked, Gasketing (odors)

Location(s): Restroom

	Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
1	Lock (mortise, privacy)	8265 V21 130LB (emergency release)	SAR
	Outside: Vacant (Green) / Occupied (Red) // Inside: Unlocked (Green) / Locked (Red)		
1	Door Closer (inside, med. traffic)	8600 T / SPA (FC)	DOR
1	Door Stop (wall-mounted preferred)	400	ROC
2	Protection Plate (kick/mop, each side)	K1050-CSK (10" high)	ROC
3	Silencer (non-rated doors only)	608-RKW / 609 / 608CA (as req'd)	ROC
1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 18

Metal / Wood ~ Push / Pull

Location(s): Locker Room, Restroom

	Hinge (hvy-duty, qty/size as req'd)	T4A3386 (1NRP@outswing)	MCK
1	Door Pull (straight)	RM301 (1 ¼" ∅, 12" length)	ROC
1	Push Plate (engraved "PUSH")	RM1010H (4" x 22" radius corners)	ROC
1	Pull Plate (engraved "PULL")	RM1010L (4" x 22" radius corners)	ROC
1	Door Closer (low profile, inside)	TS93 (coord. w/glass, secondary leaf)	DOR
1	Door Stop (wall-mounted preferred)	400	ROC
2	Protection Plate (kick/mop, each side)	K1050-CSK (10" high)	ROC
3	Silencer (non-rated doors only)	608-RKW / 609 / 608CA (as req'd)	ROC
1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 19

Steel Gate / Wire Mesh ~ Locked

Description: Mezzanine Access, Basement Access

	Pivots (qty as needed, spring-loaded)	*by Gate Fabricator*	
1	Lock (mortise, storeroom, tactile)	8204	SAR
1	Core	*per Owner/Facility Key System*	

NOTES :

- *Gate Fabricator to provide blocking to receive basis-of-design door hardware and coordinate with Door Hardware Supplier, as needed.*
- *Gate Fabricator to provide fine mesh to prevent tampering from outside and/or intrusion.*
- *Door hardware metal finishes to match gate finish.*

END OF SECTION

SECTION 088000 – GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Glass for doors and borrowed lites
   2. Glazing sealants and accessories.
   3. Privacy Film
   4. Glass Display Cabinet Glass and Hardware

B. Related Requirements:
   1. Section 081113- Hollow Metal Doors and Frames for doors scheduled to receive glass
   2. Section 081213.01- Custom Hollow Metal frames to receive glass

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.

C. IBC: International Building Code.

1.3 PERFORMANCE REQUIREMENTS

A. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
   1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

B. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Film Sample: 12 by 12 inch sample of film applied to clear glass

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.7 INFORMATIONAL SUBMITTALS

A. Product Certificates: For glass.

B. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

A. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, and insulating glass.

B. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

E. Safety Glazing Products: Comply with testing requirements in 16 CFR 120 .
1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency, acceptable to authorities having jurisdiction.
2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one

side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.11 WARRANTY

A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: Five (5) years from date of Substantial Completion.

1.12 WARRANTY

A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers Glazing: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Pilkington, NSG Group
   2. AGC North America
   3. Viracon
   4. Guardian Glass
   5. Oldcastle Building Envelope
   6. Syracuse Glass Company
   7. Vitro Architectural Glass, a PPG Company
   8. Or approved equal

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

   1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
   2. For laminated-glass lites, properties are based on products of construction indicated.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

   1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
   2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
   3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
   4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.

D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article

2.4 GLASS PRODUCTS

A. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Quality-Q3.

2.5 LAMINATED GLASS AT GYMNASIUM DOORS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Saflex; Eastman.
      b. Or approved equal
   2. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
   3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
   4. Interlayer Color: Clear unless otherwise indicated.

2.6 DISPLAY CASE GLASS DOORS AND SHELVING

A. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Quality-Q3.
   1. Minimum 3/8 inch thick.
   2. Edges: Eased and Polished

B. Display Case Hardware:
   1. Hinges: Brass Surface Mount Cabinet Pivot Hinges, equal to C.R. Laurence Item # FA50BR. Provide sill and head hinge for each leaf. Finish to be selected by architect from 4 standard finishes.
   2. Locks: Slip on Showcase Lock equal to C.R. Laurence 03P38 for 3/8-inch glass thickness. Provide 1 per leaf.
   3. Overhead Stop: Provide C.R. Laurence Double Door Stops INT308, finish to be selected.

4. Shelving Channel: Provide C.R. Laurence U-Channel for 3/8 inch glass recess SDCF38, finish to be selected.

2.7 GLASS PRIVACY FILM

A. Basis-of-Design Film: 3M FASARA™ Glass Finishes Geometric SHSCST
   1. Adhesive Type: Acrylic
   2. Application: Wet
   3. Application Surface: Flat
   4. Film Type: Polyester
   5. Opacity: Translucent
   6. Color: White
   7. Surface finish: Smooth
   8. Visible Light Reflectance: 20%
   9. Visible Light Transmittance : 55%

2.8 GLAZING SEALANTS

A. General:
   1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

2.9 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
   1. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
   1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
   2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

PART 3 - EXECUTION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

G. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

H. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

I. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

D. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

3.7 PRIVACY FILM INSTALLATION

A. Surface and Work Area Preparation

B. Use the following steps to prepare the application surface for Product application. An experienced installer’s techniques may vary.
1. Prepare the Application Solution Prepare a water and liquid detergent solution to use for applying the finish. It should have a concentration of approximately 0.1% to 0.2% detergent. A solution of about 1 teaspoon of mild detergent to 1 gallon of water is sufficient for about 36 square yards of application surface. Pour this solution into your sprayer.
2. High detergent concentration causes the applicator and finish to slip, resulting in insufficient application pressure.
3. Low detergent concentration causes the finish to stick or prevents the squeegee from traveling smoothly across the finish, which results in an inconsistent application and leaves excess water behind. Prepare the Installation Area
4. Protect the areas surrounding the installation from the application solution over spray and drips, using masking tape and/or drop cloths as appropriate.
5. If possible, turn off or cover the heating or air conditioning units and ventilation ducts in the application area prior to starting the installation.
6. For the best bonding conditions, the recommended application temperature is 54°F 100°F (12°C 38°C) and the application surface should be at room temperature or higher. In the lower end of this range, additional application pressure on the Product can encourage better adhesive bonding. Attempting to install the Product at temperatures

below the recommended range can cause the adhesive to become so firm that it will not develop maximum contact with the application surface.

C. Measure and Cut the Panels
   1. If panels are installed adjacent to each other, ensure that the panels are from the same lot. Different lots of the Product can have slight color variations that may be noticeable at seams.
   2. If film panels are installed adjacent to each other, the panels should be alternated up and down in order to accommodate slight color variations. Product panels may be cut to size by hand. If cut by hand, any nicks or burrs on the edge of the ruler used to mark and cut the finish could scratch it. Apply masking tape to the side of the ruler that contacts the finish to help prevent damage. Use a very sharp cutting blade to ensure clean, smooth edges.

3.8 GLASS DISPLAY CASE INSTALLATION

A. Coordinate, template and cut openings in glass to accommodate door hardware.

B. Install glass swinging doors and shelving hardware in strict accordance with manufacturer's written instructions.

C. Install so doors are free swinging, align vertical, leaf to leaf, and lock.

3.9 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

3.10 GLASS SCHEDULE

A. Glass Type Fully Tempered: Clear fully tempered float glass.
   1. Minimum Thickness: 6 mm .
   2. Safety glazing required.

B. Clear Laminated Glass Type: Two plies of fully tempered float glass.
   1. Minimum Thickness of Each Glass Ply: 5 mm.
   2. Interlayer Thickness: 0.090 inch.
   3.

END OF SECTION 088000

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed extruded-aluminum, storm resistant louvers.
2. Blank-off panels for louvers
3. Manufacturer's insect screens at louver locations connected to ductwork

B. Related Sections:
1. Section 07 62 00 – Sheet Metal Flashing and Trim for sill flashing
2. Section 079200- Joint Sealants for interior and exterior perimeter sealant applications.
3. Section 230000- HVAC for coordination with ductwork and mechanical equipment

1.2 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades is horizontal).

C. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing according to AMCA 500-L.

D. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing according to AMCA 540.

1.3 REFERENCES

A. Air Movement and Control Association International, Inc.
1. AMCA Standard 500-L Laboratory Methods of Testing Louvers for Rating
2. AMCA Publication 501 Application Manual for Louvers

B. The Aluminum Association Incorporated
1. Aluminum Standards and Data
2. Specifications and Guidelines for Aluminum Structures

C. American Society of Civil Engineers
1. Minimum Design Loads for Buildings and Other Structures

D. American Society for Testing and Materials
1. ASTM B209
2. ASTM B211
3. ASTM B221

4. ASTM E90-90

E. Architectural Aluminum Manufacturers Association
1. AAMA 800 Voluntary Specifications and Test Methods for Sealants
2. AAMA 605.2 Voluntary Specification for High Performance Organic Coatings on Aluminum Extrusions and Panels.
3. AAMA TIR Metal Curtain Wall Fasteners
4. AAMA 2605-98 Superior Performing Organic Coatings on Aluminum Extrusions and Panels

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Windborne-debris-impact-resistance test reports.

C. Sample Warranties: For manufacturer's special warranties.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

B. Single subcontract responsibility: Subcontract the work to a single firm that has had not less than six years’ experience in the design and manufacturing of work similar to that shown and required.

C. Performance Requirements: Provide AMCA and BSRIA test data as required to confirm that the louvers have the specified air and water performance characteristics.

D. Acoustical Performance: Where applicable, submit test reports to confirm that the louvers meet the specified STC and Noise Reduction requirements.

E. Structural Requirements: Design all materials to withstand wind and snow loads as required by the applicable building code. Maximum allowable deflection for the louver structural members to be l/180 or 0.75 inch, whichever is less. Maximum allowable deflection for the louver blades to be l/120 or 0.50 inch across the weak axis, whichever is less.

F. Warranty: Provide written warranty to the owner that all products will be free of defective materials or workmanship for a period of one year from date of installation.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 WARRANTY

A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 FIXED EXTRUDED- STORM RESISTANT ALUMINUM LOUVERS

A. Horizontal Drainable-Blade Storm Resistant Louver

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Airolite Company, LLC (The).

b. Architectural Louvers; Harray, LLC.
c. Construction Specialties, Inc.
d. Or Approved Equal

2.3 LOUVER BASIS OF DESIGN MODEL

A. CS 5" (127mm) Deep Storm Resistant Fixed Horizontal Louver Model RS-5300- 47.3% Free Area
1. Material: Heads, sills, jambs and mullions to be one-piece structural aluminum members with integral caulking slot and retaining beads. Mullions shall be sliding interlock type. Blades to be one-piece aluminum extrusions with front lip gutter and multiple secondary gutters designed to catch and direct water to sill. Louvers to be supplied with 4" (101.6mm) high by full depth sill flashings formed from minimum 0.050" (1.27mm) thick aluminum. Sill flashings to have welded side panels. Louvers and sill flashings to be installed in accordance with the manufacturer's recommended procedures to ensure complete water integrity performance of the louver system. Material thickness to be as follows: Heads, sills, jambs and mullions: 0.080" (2.06mm). Fixed blades: 0.060" (1.52mm).
2. AMCA Performance: A 4' x 4' unit shall conform to the following:
a. Free Area: 7.56 square feet
b. Intake pressure drop at 900 fpm free area velocity 0.32-inch H2O
c. Exhaust pressure drop at 900 fpm free area velocity 0.29 H2)
3. Wind Driven Rain Performance: AMCA certified and licensed to bear the AMCA seal. The louver test was based on a 39.370"(1.00m) x 39.370" (1.00 m) core area. Unit tested at a rainfall rate of 3.0 inches per hour (75 mm/hr) and with a wind directed to the face of the louver at a velocity 29.1-mph (13 m/s). The test data shall show the water penetration effectiveness rating at each corresponding ventilation rate.

2.4 LOUVER SCREENS

A. General: Provide screen at louvers connected to ductwork and mechanical equipment

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screening

B. Screens in shower rooms shall receive custom screen provided by Section 057000.

C. Secure screen frames to louver frames with stainless-steel machine screws spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

D. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Mill finish unless otherwise indicated.
3. Type: Non-re-wireable, U-shaped frames.

E. Louver Screening for Aluminum Louvers:

1. Insect Screening: Stainless steel, 18-by-18 (1.4-by-1.4-mm) mesh, 0.009-inch (0.23-mm) wire.

2.5 BLANK-OFF PANELS

A. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: 1 inch (25 mm).
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch (0.81-mm) nominal thickness.
3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch (2.03-mm) nominal thickness, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same finish applied to louvers
7. Attach blank-off panels with sheet metal screws.

2.6 FABRICATIONS

A. Provide louver models, insect screens, blank-off panels, structural supports and accessories as specified and/or shown on the drawings. Materials, sizes, depths, arrangements and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.

B. Louvers to be mechanically assembled using stainless steel or aluminum fasteners.

C. Include supports, anchorage, and accessories required for complete assembly.

D. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

2.7 MATERIALS

A. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, 6063-T6 or 6061-T6.

B. Aluminum Sheet: ASTM B3209, Alloy 1100, 3003 or 5005.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

D. Post installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as

determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.8 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide sub sills made of same material as louvers and extended sills for recessed louvers.

2.9 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. High-Performance Organic Finish: Three -coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.
2. Louvers to be finished with a minimum 1.4 mil (0.035mm) thick full strength 70% resin, 3 coat Fluoropolymer system.
3. All aluminum shall be thoroughly cleaned, etched and given a chromated conversion pre-treatment before application of the Kynar/Hylar coating. The coating shall consist of a primer, a high metallic color coat and a clear PVF_2 topcoat. It shall receive a bake cycle of 17 minutes at 450^0F. All finishing procedures shall be one continuous operation in the plant of the manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

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SECTION 090561.13 - MOISTURE VAPOR EMISSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

B. Coordinate work the following Flooring:
1. Section 096501 Resilient Flooring

1.3 DEFINITIONS

A. MVE: Moisture vapor emission.

B. MVER: Moisture vapor emission rate.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.

1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F (18 deg C) and not more than 85 deg F (29.4 deg C) at least 48 hours before use.
2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F (18 deg C) or more than 85 deg F (29.4 deg C) and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F (3 deg C) higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

1.9 MVE-CONTROL SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ARDEX Americas.
2. KOSTER American Corporation.
3. Laticrete International, Inc.
4. MAPEI Corporation.
5. Or approved equal

B. MVE-Control System: ASTM F3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.

1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.

1.10 ACCESSORIES

A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi compressive strength after 28 days when tested according to ASTM C109/C109M.

B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.

C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's gypsum cement-based underlayment.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of system indicates acceptance of surfaces and conditions.

2.2 PREPARATION

A. Preinstallation Testing:

1. Testing Agency: Owner will engage a qualified testing agency to perform tests.
2. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
   a. Anhydrous Calcium Chloride Test: ASTM F1869. Install MVE-control system in locations where concrete substrate MVER exceeds [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] <Insert rate> in 24 hours.

B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.

1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
2. Provide concrete surface profile complying with ICRI 310.2R CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.

4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
5. Fill surface depressions and irregularities with patching and leveling material.
6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.

C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

2.3 INSTALLATION

A. Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.

1. Install primers as required to comply with manufacturer's written instructions.

B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.

C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.

D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.

E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.

F. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

2.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform installation inspections.

B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.

1. Verify that surface preparation meets requirements.
2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.
3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.

C. MVE-control system will be considered defective if it does not pass inspections.

2.5 PROTECTION

A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.

B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION 090561.13

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SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstructural steel framing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For code-compliance certification of studs and track.

B. Evaluation Reports: From an agency acceptable to authorities having jurisdiction showing compliance with Project requirements, for the following:
1. Studs and track.
2. Firestop track.
3. Post-installed anchors.
4. Power-actuated fasteners.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Protect materials from corrosion, deformation, and other damage during delivery, storage, and handling in accordance with AISI S202.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Where indicated on Drawings, provide assemblies incorporating nonstructural steel framing identical to those of assemblies tested for fire resistance in accordance with ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: Where indicated on Drawings, provide assemblies incorporating nonstructural framing identical to those of assemblies tested in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.2 NONSTRUCTURAL STEEL FRAMING

A. Framing Members, General: Comply with requirements in AISI S220 for conditions indicated on Drawings.
   1. Protective Coating: STM A653, G60 or coating with demonstrated equivalent corrosion resistance. Galvannealed products are unacceptable.
      a. Equivalent Corrosion-Resistant Coating: Evaluation report acceptable to authorities having jurisdiction demonstrates corrosion resistance equivalent to specified protective coating.

B. Basis-of-Design Product: Subject to compliance with requirements, provide Clark Dietrich; ProSTUD Drywall Framing System with Smart Edge technology or comparable product by one of the following current members of the SFIA:
   1. CEMCO; California Expanded Metal Products Co.
   2. Telling Industries.
   3. Or approved equal

C. Studs and Track: AISI S220 and ASTM C645, Section 10].
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Clark Dietrich; ProSTUD Drywall Framing System with Smart Edge technology or comparable product by one of the following current members of the SFIA:
      a. CEMCO; California Expanded Metal Products Co.
      b. Telling Industries.
      c. Or approved equal.
   2. Minimum Base-Steel Thickness: 0.0329 inch
   3. Flange Size: 1-1/4 inches (32 mm).
   4. Depth: As indicated on Drawings

A. Steel Framing Stud and Deflection Track Wall System: Self-locking steel studs with telescoping stud extension with knockout in each flange to allow for 1 inch (25 mm) of deflection for fire-rated head-of-wall deflection system.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Clark Dietrich; TRAKLOC Deflection Stud (TLD) and TRAKLOC Track (TTS) or comparable product by a current member of the SFIA.
   2. Minimum Base-Steel Thickness: 0.0296 inches

B. Slip-Type Head Joints: Where indicated, provide one other following:
   1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch minimum vertical movement.
      a. Basis-of-Design Product: Subject to compliance with requirements, provide Clark Dietrich; Fast Top Clip (FTC3) or a comparable product by one of the following current members of the SFIA:
         1) CEMCO; California Expanded Metal Products Co.
         2) Steel Network, Inc. (The).
         3) Approved Equal

   2. Single Long-Leg Track System: Top track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging and spacer bar located within 12 inches (305 mm) of the top of studs to provide lateral bracing.

a. Basis-of-Design Product: Subject to compliance with requirements, provide Clark Dietrich; Deep Leg Deflection Track and Spazzer 9200 Bridging and Spacer Bar or comparable product by a current member of the SFIA.

3. Slotted Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
   a. Basis-of-Design Product: Subject to compliance with requirements, provide Clark Dietrich; MaxTrak Slotted Deflection Track or comparable product by one of the following current members of the SFIA:
      1) CEMCO; California Expanded Metal Products Co.
      2) Telling Industries.
      3) Or approved equal

C. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Clark Dietrich; BlazeFrame DL, BlazeFrame DSL, BlazeFrame or comparable product by one of the following current members of the SFIA:
      a. CEMCO; California Expanded Metal Products Co.
      b. Steel Network, Inc. (The).
      c. Or approved equal

D. Backing Plate (Contractor's Option): Proprietary fire-retardant-treated wood blocking and bracing in width indicated.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Clark Dietrich; Danback Fire-Retardant Treated Wood Backing Plate D16F or comparable product by a current member of the SFIA.

E. Flat Strap: Steel sheet for blocking and bracing in length and width indicated.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Clark Dietrich; Flat Strap or comparable product by a current member of the SFIA.
   2. Minimum Base-Steel Thickness: 0.0296 inch.

F. Channel Bridging and Bracing: Pre-notched steel, 7/8 by 7/8 by 50 inches (22.2 by 22.2 by 1270 mm), 0.0329-inch- (0.84-mm-) minimum base-steel thickness.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Clark Dietrich; Spazzer 9200 (SPZD) or comparable product by a current member of the SFIA.

G. Rigid Furring Channels: Hat-shaped channels for furring out walls.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Clark Dietrich; Furring Channel or comparable product by a current member of the SFIA.
   2. Minimum Base-Steel Thickness 0.0296 inch.
   3. Depth: 7/8 inch

H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

   1. Basis-of-Design Product: Subject to compliance with requirements, provide Clark Dietrich; RC Deluxe or comparable product by a current member of the SFIA.

2. Configuration: Asymmetrical.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Adjustable Wall-Furring Brackets: ASTM A653/A653M G60 hot-dip galvanized steel sheet in minimum 0.0329-inch- (0.836-mm-) base-steel thickness with serrated edges for attaching furring channels to exterior masonry or concrete walls.

C. Post-Installed Anchors: Fastener systems with an evaluation report, acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, or AC308 as appropriate for the substrate.

D. Power-Actuated Anchors: Fastener systems with an evaluation report, acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Isolation Strip at Exterior Walls: Provide[one of] the following:
   1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, substrates, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF NONSTRUCTURAL METAL FRAMING, GENERAL

A. Installation Standard: ASTM C754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with framing members. Frame both sides of joints independently.

3.3 INSTALLATION OF NONSTRUCTURAL STEEL FRAMING

A. Install framing system components at spacings indicated on Drawings, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install track at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated on Drawings to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
   1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
   2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
   3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated on Drawings. Install framing below sills of openings to match framing required above door heads.
   4. STC-Rated Partitions: Install framing to comply with STC-rated assembly indicated on Drawings.

E. Direct Furring:
   1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Wall-Furring Bracket Systems: Install brackets with serrated edges facing upward spaced at minimum 48 inches (1219 mm) o.c. vertically with 6 inches (152 mm) maximum from floor and ceiling, and minimum 36 inches (914 mm) o.c. horizontally with 4 inches (102 mm) maximum from abutting construction, unless otherwise indicated on Drawings.

END OF SECTION 092216

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Interior gypsum board.
   2. Abuse resistant gypsum wall board
   3. Moisture resistant gypsum wall board in lockers, showers, toilet rooms
   4. Tile backing panels at wall tile applications
   5. Acoustic Insulation and sealant

B. Related Requirements:
   1. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
   2. Section 093300 “Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Gypsum wallboard.
   2. Gypsum board, Type X.
   3. Gypsum ceiling board.
   4. Impact-resistant gypsum board.
   5. Mold-resistant gypsum board.
   6. Cementitious backer units.
   7. Water-resistant gypsum backing board.
   8. Interior trim.
   9. Joint treatment materials.
   10. Laminating adhesive.
   11. Sound-attenuation blankets.
   12. Acoustical sealant.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
3.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Gypsum.
b. CertainTeed Corporation.
c. Georgia-Pacific Building Products.
d. National Gypsum Company.
2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered

B. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Gypsum.
b. CertainTeed Corporation.
c. Georgia-Pacific Building Products.
d. National Gypsum Company.
e. <Insert manufacturer's name>.
2. Core: 5/8 inch (15.9 mm), Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Gypsum.
   b. CertainTeed Corporation.
   c. Georgia-Pacific Building Products.
   d. National Gypsum Company.
2. Thickness: 1/2 inch (12.7 mm).
3. Long Edges: Tapered.

2.3 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation.
      b. James Hardie Building Products, Inc.
      c. National Gypsum Company.
   2. Thickness: 5/8 inch (15.9 mm).
   3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
   2. Shapes:
      a. Cornerbead.
      b. LC-Bead: J-shaped; exposed long flange receives joint compound.
      c. L-Bead: L-shaped; exposed long flange receives joint compound.
      d. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.
   2. Exterior Gypsum Soffit Board: Paper.
   3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.

E. Joint Compound for Tile Backing Panels:
1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

D. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Hilti, Inc.
b. Pecora Corporation.
c. Specified Technologies, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with

manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on Drawings.
2. Type X: As indicated on Drawings
3. Ceiling Type: Ceiling surfaces.
4. Abuse-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws fasten face layers with adhesive and supplementary fasteners.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at interior tile application. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

B. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings, and according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. L-Bead: Use at exposed panel edges

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

3.6 FINISHING GYPSUM BOARD

A. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

B. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 09 33 00 – TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Floor Tile and Base
   2. Wall Tile
   3. Stone Thresholds where indicated
   4. Metal Trims at tiles

1.3 SUBMITTALS -TILE

A. Product Data: For each type of tile, mortar, grout, and other products specified.

B. Delete below if tile installations are not extensive or complex enough to justify Shop Drawings.

C. Tile Samples for Initial Selection: Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.

D. Grout Samples for Initial Selection: Manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.

E. Samples for Verification: Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.

   1. Each type and composition of tile and for each color and texture required, at least 12 inches (300 mm) square, mounted on braced cementitious backer units, and with grouted joints using product complying with specified requirements and approved for completed work in color or colors selected by Architect.
   2. Full-size units of each type of trim and accessory for each color required.
   3. Stone thresholds in 6-inch (150-mm) lengths.

1.4 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each

contiguous area of consistent quality in appearance and physical properties without delaying the Work.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:

1. Stone thresholds.
2. Waterproofing.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.7 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS PORCELAIN AND CERAMIC TILE

A. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:
1. Mortars, adhesives & Grouts:

a. Bostik Corp. (Hydroment), Middleton MA.
b. C-Cure Chemical Company, Inc., Houston TX
c. Custom Building Products, Inc., Seal Beach, CA.
d. Laticrete International, Inc., Bethany CT
e. Mapei Corporation, Elk Grove IL.
f. TEK Special Construction Brands, Inc. (division of HB Fuller), Arlington Heights IL.

2. Edging materials:
a. Schlüter Systems L.P., Plattsburgh NY.
b. Ceramic Tool Company Inc., Waukesha WI.
c. Akdo Intertrade, Inc., Bridgeport, CT.

2.2 TILE TYPES

A. Refer to Drawing Sheet A700 for Basis of Design Ceramic and Porcelain tile types.

TILE

CT-1: BEST TILE
WAVE - ASH
4X4
MATTE FINISH
RESTROOM/LOCKER ROOM FLOORS

CT-2: DALTILE
4X12 TILE COVE BASE TO MATCH WALL COLOR

CT-3: DALTILE
COLOR WHEEL LINEAR - MATTE ARCTIC WHITE
4X12 SUBWAY TILE

CT-4: DALTILE
COLOR WHEEL CLASSIC- MUSTARD
6X6 ACCENT TILE
LOCKER ROOMS

CT-4A: DALTILE
FLAT TOP COVE BASE - MUSTARD
6X6
LOCKER ROOMS

CT-5: DALTILE
COLOR WHEEL CLASSIC - ELECTRIC BLUE
6X6 ACCENT TILE
LOCKER ROOMS

CT-5A: DALTILE
FLAT TOP COVE BASE - ELECTRIC BLUE
6X6
LOCKER ROOMS

PORCELAIN TILE

PC-1: DALTILE
12X24 PORCELAIN FLOOR TILE
VOLUME 1.0 - TRUFFLE

PC-1A: DALTILE
6 X12 PORCELAIN BASE COVE BASE

B.

2.3 STONE THRESHOLDS

A. Where indicated on the Drawings, provide marble thresholds complying with Class "A" of the Marble Institute of America, in color selected by the Architect from standard colors of the approved fabricator, shaped to provide a comfortable transition between tile and other floor finishes, with smooth matte surface finish and in the dimensions and thickness shown on the Drawings.

2.4 SETTING MATERIALS GENERAL

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
   1. Cleavage Membrane: Asphalt felt, ASTM D226/D226M, Type I (No. 15); or polyethylene sheeting, ASTM D4397, 4.0 mils (0.1 mm) thick.
   2. Factory blended portland cement and graded aggregates.
   3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

B. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Laticrete International, Inc.
      b. MAPEI Corporation.
      c. Southern Grouts & Mortars, Inc.
      d. Or approved equal
   2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
   3. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.

2.5 GROUTING FLOORS

A. Latex-Portland Cement Grout: ANSI A118.6 for materials described in Section H-2.4, composed as follows:
   1. Mixture of Dry-Grout Mix and Latex Additive: Mixture of factory-prepared, dry-grout mix and latex additive complying with the following requirements:
      a. Sanded Dry-Grout Mix: Commercial portland cement grout complying with ANSI A118.6 for materials described in Section H-2.1, for joints 1/8 inch (3.2 mm) and wider.
      b. Latex Additive: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.

B. Epoxy grout at Lockers and Wet Areas: Multi-component epoxy grout, stain resistant, conforming to ANSI 118.3.
   1. Epoxy Grout shall be non-toxic, non-flammable, non-hazardous during storage, mixing, application and when cured and shall meet the following minimum physical requirements in compliance with ANSI A118.3 test methods:

a. Compressive Strength: 6600 psi (464 kg/cm2)min.
b. Shear Bond Strength: 100 psi (70kg/cm2)min.
c. Water Absorption: 1/2% max.
d. Service Temperature: up to 230¯F (110¯C)

2. The finished Epoxy grout shall be chemically and stain resistant to catsup, mustard, tea, coffee, milk, soda, beer, wine, bleach (5% solution), ammonia, juices, vegetable oil, brine, sugar, cosmetics, and blood. It shall also be chemically resistant to dilute acids and alkalis, gasoline, turpentine, and mineral spirits.
   a. Acceptable products are :
      1) Mapei product: “Kerapoxy, KER 400” series.
      2) Laticrete product “Latapoxy 2000”. Series.
      3) Custom Building Products 100% Solids Epoxy.

2.6 GROUTING –WALLS

A. Grout for walls having joints less than 1/8-inch width: Acrylic modified Portland cement (unsanded) grout conforming to ANSI 118.6. Acceptable products are :
   1. Mapei product: “Ker-800” with acrylic latex additive “Plastijoints”,
   2. Laticrete product “Laticrete 1600 Series (unsanded) with admix 1776 antimicrobial.
   3. Custom Building Products PolyBlend unsanded grouts.

2.7 ACCESSORIES AT TILES

A. Edge strips at wall Caps: Schlüter Systems L.P., product series “Jolly”, in height as required for tile thickness, roll-formed from aluminum with a perforated anchoring leg. Finish is brushed chrome anodized.

2.8 CRACK TREATMENT AT CONCRETE CONSTRUCTION JOINTS

A. Anti-fracture membrane for crack suppression and substrate crack isolation:
   1. Acceptable products include the following, or approved equal:
      a. Mapei product: “Plani/Lastic”.
      b. Laticrete product “Blue 92”.
      c. Custom Building Products “Crack Buster Pro” or Fracture Free
      d. TEC product 1flex Crack Isolation Membrane.
      e. Bostik Corp. (Hydroment), product “Hydroment Gold”.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayment and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

3.2 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

3.3 CRACK SUPPRESSION

A. Provide crack suppression assembly over all concrete control joints and joints between different substrates.

3.4 WALL TILE INSTALLATION - TCNA NUMBER W244C WITH THIN-SET

A. General: Install in accordance with ANSI A108.5, TCNA installation method number W244C, and as additionally specified herein below. Apply materials in strict accordance with the written instructions and recommendations of setting materials manufacturer.
   1. Setting materials: Latex modified Portland cement (ANSI A118.4).
   2. Grout materials: Acrylic modified Portland cement (unsanded) grout (ANSI A118.6).

3.5 FLOORING INSTALLATION TILES – TCNA NUMBER F113A-11

A. Description: Thin-set tile over concrete.

B. General: TCNA installation method number F113A-11, and as additionally specified herein below. Apply materials in strict accordance with the written instructions and recommendations of setting materials manufacturer.
   1. Cementitious Bond Coat: ANSI 118.4
   2. Grout materials: Cementitious Grout ANSI 108.17
   3. Crack Isolation Membrane: ANSI A108.17

3.6 FLOORING INSTALLATION TILES- TCNA NUMBER F111-11

A. Description: Full Mortar Bed over concrete at slab depressions

B. General: TCNA installation method number F111-11, and as additionally specified below. Apply materials in strict accordance with the written instructions and recommendations of setting materials manufacturer.
   1. Cleavage Membrane A108.1A
   2. Mortar Latex-portland cement mortar ANSI A118.4
   3. Cementitious Grout: Ansi A108.10
   4. Epoxy Grout at Kitchen: A108.6

3.7 FLOORING INSTALLTION TILES-F180-11

A. Description: TCNA installation method number F180-11, Tile over poured gypsum underlayment with bonded membrane
   1. Primer sealer as recommended by membrane manufacturer
   2. Waterproof membrane: ANSI A118.10
   3. Cementitious Bond Coat: ANSI A118.4
   4. Cementitious Grout: A108.10

3.8 BASE TILE INSTALLATION

A. General: Install in accordance with ANSI A108.5, TCNA installation method number W244C, and as additionally specified herein below. Apply materials in strict accordance with the written instructions and recommendations of setting materials manufacturer.
   1. Setting materials: Latex modified Portland cement (ANSI A118.4).
   2. Grout materials: Acrylic modified Portland cement (unsanded) grout (ANSI A118.6).

3.9 INSTALLATION – GROUT –CERAMIC TILE

A. Force the maximum amount of the approved grout into joints in accordance with pertinent recommendations contained in ANSI A108.10.

END OF SECTION 09 33 00

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SECTION 09 51 00 – ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 FILING SUB-BIDS

1.2 SUMMARY

A. This Section includes:
   1. Ceilings consisting of acoustical panels and exposed suspension systems.
   2. Perimeter Trim

B. Related Work:
   1. Section 210000- Fire Protection for coordination with sprinkler heads.
   2. Section 230000- HVAC for coordination of mechanical equipment.
   3. Section 260000- Electrical for coordination with light fixtures

1.3 SUBMITTALS

A. Product Data: For each type of product specified.

B. Samples for Selection: Manufacturer's color charts consisting of actual acoustical panels or sections of acoustical panels, suspension systems, and moldings showing the full range of colors, textures, and patterns available for each type of ceiling assembly indicated.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products.

E. Research/Evaluation Reports: Evidence of acoustical panel ceiling's and components' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

B. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
   1. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

   1. Acoustical Ceiling Units: Full-size units equal to 2.0 percent of amount installed.
   2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
   1. Armstrong World Industries, Inc.

2. BPB Celotex Corporation; Architectural Ceilings Marketing Dept.
3. USG Interiors, Inc.
4. Certainteed, Inc.
5. or approved qual.

2.2 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.

B. Panel Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3, including those referencing ASTM E 1264 classifications.

2.3 ACOUSTICAL TILE DESCRIPTIONS

A. Nodular, Mineral-Base Acoustical Panels for Acoustical Ceiling Type 1: Where this designation is indicated, provide acoustical panels, complying with the following:

1. Products: Provide the following or approved equal:
2. Armstrong Optima PB 3355
3. Thickness: 1- inch
4. Size: 24 by 24 inches
5. Edge: Square tegular; 9/16 inch
6. NRC 0.90
7. CAC: 26
8. Architectural Class: 190
9. Light Reflectance: 0.88
10. Color: White

B. Nodular, Mineral-Base Acoustical Panels for Acoustical Ceiling Type 2: Where this designation is indicated, provide acoustical panels, complying with the following:

1. Products: Provide the following or approved equal:
2. Armstrong Ultima High NRC 2082
3. Thickness: 1- inch
4. Size: 24 by 24 inches
5. Edge: beveled tegular; 9/16 inch
6. NRC 0.85
7. CAC: 35
8. Architectural Class: 170
9. Light Reflectance: 0.85
10. Color: White

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

2.5 SUSPENSION SYSTEMS DESCRIPTION

A. Suspension System for Acoustical Tile Ceilings:
   1. Type 1 & 2Ceiling: Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/653M, G01 (Z001) coating designation, with prefinished 9/16-inch- wide metal caps on flanges; other characteristics as follows:
      a. Structural Classification: Intermediate-duty system.
      b. End Condition of Cross Runners: Coupling.
      c. Face Design: Flush face.
      d. Cap Material: Steel sheet
      e. Cap Finish: Painted white
      f. Basis of Design: Armstrong 9/16 inch Suprafine®

2.6 METAL EDGE MOLDINGS AND TRIM

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corporation.
   3. Fry Reglet Corporation.
   4. Gordon, Inc.
   5. Rockfon (Rockwool International).
   6. Or approved equal

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.
   1. Straight Wall
   2. Flat angle
   3. Finish: Painted white

C. Perimeter Trim
   1. Product/Manufacturer: Axiom® Classic Perimeter Trim; Armstrong World Industries, Inc.
   2. Components: Edge trim system for suspended ceiling system, extruded aluminum alloy 6063 trim channel, 12 foot straight with inside corners
   3. Axiom Trim Channel Straight: Six (6) inch wide face with 3/4 inch horizontal legs, straight sections with special bosses formed for attachment to the Axiom tee-bar connection clip or hanging clip; commercial quality, extruded aluminum, factory-finished in (factory-applied baked polyester paint to match Armstrong to match grid color.

4. Axiom Outside Corners (Straight Only): Commercial quality extruded aluminum sections formed to match the Axiom trim channel profile that connect to straight Axiom sections, 12 inch x 3/4 inch x six (6) inch factory-finished in factory-applied baked polyester paint to match Armstrong match grid and Axiom straight sections.
5.

2.7 ACOUSTICAL SEALANT

A. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

B. Products: Subject to compliance with requirements, provide one of the following:
1. BA-98; Pecora Corp.
2. Tremco Acoustical Sealant; Tremco, Inc.
3. USG Acoustical Sealant
4. or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.

3.2 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders and comply with layout shown on reflected ceiling plans.

3.3 EXAMINATION

A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.

3.4 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders and comply with layout shown on reflected ceiling plans.

3.5 INSTALLATION

A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
2. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
3. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
3. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
4. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches (200 mm) from ends of each member.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

3.6 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095100

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SECTION 09 65 01 – RESLIENT FLOORING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Resilient wall base and accessories.
   2. Vinyl Composition Tile
   3. Static Control Flooring
   4. Luxury Vinyl Tile (Vinyl Plank Flooring)

B. Work includes preparation of new substrates to receive resilient flooring products including leveling up to ½ inch plus or minus from average finish floor elevation, patching of voids, repair and treatment of cracks, and other imperfections.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of floor tile indicated.

C. Samples for Verification: Full-size units of each color and pattern of floor tile required.

D. Product Schedule: For floor tile.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than **70 deg F** or more than **95 deg F** , in spaces to receive floor tile during the following periods:
1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than **55 deg F** or more than **95 deg F.**

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Furnish not less than one box for each 50 boxes or fraction thereof, of each type, color, pattern, class, wearing surface, and size of resilient tile flooring installed.
2. Furnish not less than 10 linear feet (3 linear m) for each 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient accessory installed.
3. Deliver extra materials to Owner.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION TILE FLOORING

A. Vinyl Composition Tile (VCT-1): 12 x 12 inch by 1/8 inch thick with solid color extending through thickness of tile; composed of vinyl resins, non-asbestos inorganic mineral fillers, and colorfast pigments complying with FS SS-T-312B(1), Type IV, Composition 1 and ASTM F1066 Composition 1, Class 2.

1. Provide indicated on drawing A700 or approved equal.

VCT-1: ARMSTRONG EXCELON IMPERIAL TEXTURE
SOFT WARM GRAY
12" X 12"
STORAGE, KITCHENETTE, AV

VCT-2: ARMSTRONG EXCELON IMPERIAL TEXTURE - SOFT WARM GRAY
12" X 12"
JANITOR CLOSETS

2.

2.2 LUXURY VINYL TILE FLOORING

A. Provide indicated on drawing A700 or approved equal.

LVT-1: SHAW CONTRACT
FUNCTION 5.0 - 86100 SILICA
18" X 18" TILE
5 MM
CORRIDORS

LVT-2: JNJ FLOORING
MAKE YOUR MARK - 1072 MARIGOLD
9" X 48" PLANKS
5 MM
CORRIDOR ACCENT

LVT-3: SHAW CONTRACT
CODED - 43715 FLUENT
6" X 48" PLANKS
5 MM
LOUNGE

LVT-4: SHAW CONTRACT
CODED - 43518 IMPLY
6" X 48" PLANKS
5 MM
COMPUTER ROOM

LVT-5: SHAW CONTRACT
COMPOUND 5.0 - 77525 ONSET
24" X 24" TILE
5 MM
SHOWER ROOMS

LVT-6: TBD

LVT-7: JNJ FLOORING
MAKE YOUR MARK - 1074 CANDY
9" X 48" PLANKS
5 MM
MPR ACCENT

B.

2.3 THERMOPLASTIC RUBBER ACCESSORY MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Armstrong World Industries, Inc.
   2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
   3. Flexco.
   4. Johnsonite; a Tarkett company.
   5. Nora Systems, Inc.
   6. Roppe Corporation, USA.
   7. Or approved equal

2.4 RUBBER BASE

A. Product Standard: ASTM F1861,

B. Provide indicated on drawing A700 or approved equal.

C.

RB-1: TARKETT
6" RUBBER BASE, COVE PROFILE
24 GREY HAZE
CORRIDORS, MULTIPURPOSE ROOM

RB-2: TARKETT
4" RUBBER BASE, COVE PROFILE
24 GREY HAZE
OFFICES, ZOOM ROOMS, COMPUTER ROOM, LOUNGE

RB-3: TARKETT
4" RUBBER BASE, COVE PROFILE
COLOR TBD
STORAGE, JANITOR CLOSETS, KITCHENETTE

2.5 RUBBER MOLDING ACCESSORY

A. Description: Rubber
   1. reducer strip for resilient floor covering to concrete slab
   2. transition strips between resilient floor types

B. Profile and Dimensions: As indicated

C. Locations: Provide rubber molding accessories in areas indicated.

D. Colors and Patterns: Solid color selected by Architect from manufacturer's full range of colors.

2.6 ACCESSORIES

A. Filler for patching, smoothing and leveling subfloors and underlayments: Portland cement-based latex underlayment acceptable to flooring manufacturer, equal to the following:

1. Ardex, Inc., products “Feather Flash” and “Ardex SD-P”.
2. Quikrete Companies, product “Fast-Set Underlayment 1248”.
3. Silpro Masonry Systems Inc., product “Profinish”.

B. Adhesives
1. General: Water resistant, acceptable to the resilient flooring manufacturer, for substrate conditions.

C. Transition and edge strips:
1. General: Homogeneous vinyl, of profiles required for thickness of abutting materials.
2. Edge strips: Tapered or bull nose edge.
3. Colors: Match or contrast with the flooring, as selected by the Architect from standard colors available, of width shown on the drawings.

D. Cleaning material: Domestic neutral floor detergent having a pH 7 or pH 8, as recommended by the flooring manufacturer.

E. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.

3.2 TILE INSTALLATION

A. General: Comply with tile manufacturer's written installation instructions.

3.3 INSTALLATION – VINYL PLANK

A. Lay flooring in a square grid pattern, with joints and seams parallel to building lines. Lay tile flooring with pattern-grain running in singular direction approved by Architect. Lay plank with joints straight and continuous in both directions and with border planks not less than 1/2 the width of the tile.

3.4 RESILIENT ACCESSORY INSTALLATION

A. General: Install resilient accessories according to manufacturer's written installation instructions.

END OF SECTION 09 65 01

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SECTION 096700 – SEAMLESS QUARTZ FLOORING

PART 1 - GENERAL

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. Section Includes seamless epoxy surfacing material, integral base, including surface preparation, primers and finish coats. Work includes:
   1. Abrasive blasting or mechanical grinding to prepare substrate.
   2. ¼ to 3/8-inch (approximate) floor with high solids topcoat for general application.
   3. Metal edge trim at top of epoxy base.
      a. Bedding sealant for stainless steel edge is part of the work of this Section.
   4. Metal floor transition where floor color changes

B. Related Section:
   a. Division 3 Section “Cast-in-Place Work” for coordination of concrete finishing and epoxy flooring application.
   b. Division 7 Section "Joint Sealants" for sealants installed with epoxy flooring

1.3 SUBMITTALS

A. Shop Drawings: Include installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:
   1. Control Joint Details
   2. Wall Base Details
   3. Transition Details

B. Samples for Initial Selection: Manufacturer's color plates showing the full range of colors and patterns available.

C. Samples for Verification: For each type, material, color, and pattern of epoxy flooring and accessory required showing the full range of color, texture, and pattern variations expected. Label each epoxy flooring sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare samples of same thickness and from same material to be used for the Work in size indicated below:
   1. Epoxy: 6-inch- (150-mm-) square Samples.

D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

E. Qualification Data: For qualified Installer.

F. Material Certificates: For each type of epoxy flooring material or product, from manufacturer.

G. Maintenance Data: For epoxy flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who is acceptable to epoxy flooring manufacturer to install manufacturer's products.

B. Source Limitations: Obtain primary epoxy materials from one source from a single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

1.5 DELIVERY STORAGE AND HANDLING

A. Deliver material to job site in clean, clearly labeled containers and inspect prior to start of job.

B. Store material in a dry, enclosed area protected from the elements. Keep temperature of storage area between 60o and 90o F.

1.6 ENVIRONMENTAL REQUIRMENTS

A. Cure new concrete no less than 28 days under good conditions. Follow manufacturer’s guidelines to check concrete substrate for proper readings before proceeding with flooring installation.

B. Verify that substrate is properly equipped with vapor barriers and perimeter drains.

C. Verify supply of adequate utilities, including electric, water, heat (between 60o and 90o F.) and lighting of no less than 80 ft candles measured at floor surface.

D. Free work area of other trades during, and for a period of 24 hours, after floor installation.

E. Protect finished floor from damage by subsequent trades.

1.7 WARRANTY

A. Submit a one-year warranty against defects in material and workmanship upon substantial completion of installation.

PART 2 - PRODUCTS

2.1 BASIS-OF-DESIGN

A. Basis-of-Design Product: Subject to compliance with requirements, provide epoxy flooring by DUR-A-FLEX, INC. or a comparable product by one of the following:
   1. DEX-O-TEX by Crossfield Products, Corp.

2. Crown Polymers, LLC
3. Key Resin Company
4. Terrazzo & Marble Supply Companies
5. Or approved equal.

B. Standard Flooring: Dur-A-Flex, Inc, Hybri-Flex EQ (self leveling broadcast quartz), epoxy/aliphatic urethane topcoat seamless flooring system.
1. System Materials:
   a. Topping: Dur-A-Flex, Inc, Poly-Crete MD resin, hardener and SL aggregate.
   b. The broadcast aggregate shall be Dur-A-Flex, Inc. Q28 quartz aggregate.
   c. Color: One color to be selected from manufacturer's full range of color.
   d. Broadcast: Dur-A-Flex, Inc. Dur-A-Glaze #4, epoxy based two-component resin.
   e. Seal coats: Dur-A-Flex, Inc Dur-A-Glaze #4, epoxy-based, two-component resin.
   f. Topcoat: Dur-A-Flex, Inc. Poly-Thane 2HS aliphatic urethane 2 component resin.
2. Patch Materials
   a. Shallow Fill and Patching: Use Dur-A-Flex, Inc. Poly-Crete MD (up to ¼ inch).
   b. Deep Fill and Sloping Material (over ¼ inch): Use Dur-A-Flex, Inc. Poly-Crete WR.

2.2 BASIS OF DESIGN PRODUCT REQUIREMENTS

A.	Topping	Poly-Crete SL
1.	Percent Reactive	100 %
2.	VOC	0 g/L
3.	Bond Strength to Concrete ASTM D 4541	400 psi, substrates fail
4.	Compressive Strength, ASTM C579	7,250 psi
5.	Tensile Strength, ASTM D 638	750 psi
6.	Flexural Strength, ASTM D 790	4,400 psi
7.	Impact Resistance @ 125 mils, MIL D-3134,	160-inch lbs.
8.	No visible damage or deterioration	

B.	Broadcast Coat	Dur-A-Glaze #4 Resin
1.	Percent Reactive,	100 %
2.	VOC	<4 g/L
3.	Water Absorption, ASTM D 570	0.04%
4.	Tensile Strength, ASTM D 638	4000psi
5.	Coefficient of thermal expansion ASTM D 696,	2 x 10^{-5} in/in/F
6.	Flammability ASTM D-635	Self-Extinguishing
7.	Flame Spread/ NFPA 101 ASTM E-84	Class A

C.	Topcoat	Poly-Thane 2 HS
1.	VOC	320.8 g/L
2.	60 Degree Gloss ASTM D523	90+
3.	Tensile strength, ASTM D 638	7,000 psi
4.	Elongation ASTM D2370	9%
5.	Abrasion Resistance ASTM D-460	10 mg loss
6.	CS 17 1,000 gm load, 1,000 cycles	
7.	Pot life @ 68 F	2 hours

8.	Dry properties, 72°F, 50% R.H.	6-8 hours
9.	hard Dry	12 hours
10.	Full Chemical resistance	7 days

2.3 METALTRIM

A. Top of Wall Base: Provide Schluter Systems 1.2 SCHIENE, E60, Type 304 stainless steel.

B. Fasteners shall be 3/16 inch by 1 ¾ inch, stainless steel flat-head screw. Use Tapcon or approved equal.

C. Bedding Sealant shall be:
   1. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
   2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Pecora Corporation; 898.
      b. Or equal.

2.4 PRODUCT MIXING

A. Mix on site with manufacturer supplied mixing and measure apparatus to ensure a timely, accurate mix ratio and minimize waste.

PART 3 - EXECUTION

3.1 INSPECTION

A. Moisture Testing: Perform anhydrous calcium chloride test ASTM F 1869-98.
   1. Perform three tests for the first 1,000 sf and then one test per 1,000 sf after that.
   2. Application will proceed only when the vapor/moisture emission rates from the slab is less than and not higher than 12 lbs/1,000 sf/24 hrs.
   3. If the vapor drive exceeds 12 lbs/1,000 sf/24 hrs provide a vapor mitigation system that has been approved by the manufacturer or other means to lower the value to the acceptable limit.

3.2 PREPARATION

A. Create a surface profile with a steel shot blast machine, scarifier, and dust-free diamond grinders for edges. Remove all unsound areas of existing epoxy flooring.

B. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.

C. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/4-inch key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges

D. Cracks and joints (non-moving) greater than 1/8-inch-wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.

E. Verify that surface is dry and perfectly clean, free of all oil, grease, detergent film, sealers and/or curing compounds.

3.3 DRAINAGE

A. New concrete slabs shall be sloped to drain. Installer shall verify positive drainage and report poor drainage or ponding to Contractor.

B. Provide shall fill and patching material to create positive drainage.

3.4 INSTALLATION – METAL TRIM

A. At the top of integral base applied to masonry walls provide a stainless-steel trim strip to terminate the top of the quartz flooring.

B. Establish level line around entire application of integral wall base, metal trim shall become finish and screed for integral base.

C. Mechanically fasten trim to masonry using screws.
   1. Pre-drill pilot hole to secure screw into masonry.

D. Bed trim in sealant to ensure back of trim is sealed against the masonry

3.5 INSTALLATION – STANDARD FLOORING

A. General: The system shall be applied in five distinct steps as listed below:
   1. Substrate preparation
   2. Topping/overlay application with quartz aggregate broadcast.
   3. Resin application with quartz aggregate broadcast.
   4. Topcoat application
   5. Second topcoat application.
   6. Immediately prior to the application of any component of the system, the surface shall be dry, and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
   7. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
   8. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architect.
   9. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

B. Topping
   1. The topping shall be applied as a self-leveling system as specified by the Architect. The topping shall be applied in one lift with a nominal thickness of 1/8 inch.
   2. The topping shall be comprised of three components, a resin, hardener and filler as supplied by the Manufacturer.
   3. The hardener shall be added to the resin and thoroughly dispersed by suitably approved mechanical means. SL Aggregate shall then be added to the catalyzed mixture and mixed in a manner to achieve a homogenous blend.
   4. The topping shall be applied over horizontal surfaces using ½ inch "v" notched squeegee, trowels or other systems approved by the Manufacturer.
   5. Immediately upon placing, the topping shall be degassed with a loop roller.
   6. Quartz aggregate shall be broadcast to excess into the wet material at the rate of 0.8 lbs/sf.
   7. Allow material to fully cure. Vacuum sweep and/or blow to remove all loose aggregate.

C. Broadcast
   1. The broadcast coat resin shall be applied at the rate of 50 sf/gal.
   2. The broadcast coat shall be comprised of liquid components, combined at a ratio of 2 parts resin to 1-part hardener by volume and shall be thoroughly blended by mechanical means such as a high-speed paddle mixer.
   3. Quartz aggregate shall be broadcast into the wet resin at the rate of 0.5 lbs/sf.
   4. Allow material to fully cure. Vacuum sweep and/or blow to remove all loose aggregate.

D. Topcoat
   1. The first topcoat shall be squeegee applied with a coverage rate of 50 sf/gal.
   2. The topcoat shall be comprised of liquid components, combined at a ratio of 2 parts resin to 1-part hardener by volume and shall be thoroughly blended by mechanical means such as a high-speed paddle mixer.
   3. The first topcoat will be back rolled, and cross rolled to provide a uniform texture and finish

E. The second topcoat shall be roller applier with a coverage rate of 300 sf/gal.

F. The finish floor will have a nominal thickness of ¼ to 3/8 inch.

3.6 CLEANING AND PROTECTION

A. Cleaning:

   1. Remove debris and application materials from installation and adjacent areas.
   2. Wash surfaces with cleaner according to written recommendations and manufacturer's written instructions; rinse surfaces with water and allow to dry thoroughly.

B. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that epoxy flooring is without damage or deterioration at time of Substantial Completion.

END OF SECTION 096700

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following: surface preparation and field painting of the following:
   1. Exposed exterior items and surfaces.
   2. Exposed interior items and surfaces.
   3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
   4. Surface preparation of existing glazed masonry surfaces.
   5. Surface preparation of existing wood elements in former pool area (multi-purpose room)

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
   1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

C. Work of this section includes all scaffolding, staging, hoisting, and rigging required to perform the work.

1.2 SCHEDULE OF PAINT TYPES

A. Exterior and interior paint types are scheduled at the end of this Section. The following types shall be used as follows:
   1. Exterior: (Including Filter and Storage Room
      a. Concrete: Low Lustre
      b. CMU: Low Lustre
      c. Wood: Semi-Gloss, except where deep colors are required.
      d. Plywood: Low Lustre
      e. Ferrous Metal Typical: Exposed to View: Semi-Gloss
      f. Ferrous Metal Not Exposed to View: Low Lustre
   2. Interior:
      a. Concrete: Semi-Gloss
      b. CMU: Semi-Gloss
      c. Gypsum Board: Egg Shell on walls in all public areas.
      d. Gypsum Board Ceilings: Low Lustre
      e. Plaster In All Public Areas: Eggshell
      f. Woodwork: Semi-gloss
      g. Ferrous Metal: Semi-Gloss

h. Zinc-coated metal: Semi-gloss

1.3 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F (10 and 32 deg C).

B. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
1. Benjamin Moore & Co. (Moore).
2. PPG Industries, Inc. (PPG).
3. Sherwin-Williams Co. (S-W)
4. Or approved equal

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Colors: Match colors indicated by reference to manufacturer's color designations.

C. Colors: Provide color selections made by the Architect. Each room, element, or surface may contain multiple colors.

2.3 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution for glazed masonry and wood: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for every 5 gal. (20 L) of solution required.

D. Mildewcide for former pool wood: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

3.3 PREPARATION OF GLAZED MASONRY SURFACES

A. Remove surface contamination using TSP (Trisodium Phosphate) or mixture of 3-parts water and 1-part bleach.
   1. Use stiff brush, sponges, or a combination of both
   2. Properly handle and dispose of run-off.

B. After initial cleaning, scuff sand or scrub with an abrasive to improve adhesion.
   1. Wet wipe after scuffing to remove residual.
   2. Do not proceed with application of primer until surface is completely dry.

3.4 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

3.5 EXTERIOR PAINT SCHEDULE

A. Concrete Nontraffic Surfaces:
   1. Latex System:
      a. Prime Coat: Primer sealer, latex.
         1) S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
      b. Prime Coat: Latex, exterior, matching topcoat.
      c. Intermediate Coat: Latex, exterior, matching topcoat.
      d. Topcoat: Latex, exterior, low sheen.

1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

B. CMU Substrates:
1. Latex System:
a. Block Filler: Block filler, latex, interior/exterior:
1) S-W PrepRite Block Filler, B25W25, at 75 to 125 sq. ft. per gal. (1.84 to 3.07 sq. m per liter).
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, low sheen.
1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

C. Ferrous Metal, Galvanized-Metal, and Aluminum Substrates:
1. Water-Based Light Industrial Coating System:
a. Prime Coat: Primer, water based.
1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, 5.0 to 10.0 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
c. Topcoat: Light industrial coating, exterior, water based, semi-gloss.
1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.

D. Wood Substrates Opaque Finish: Including exposed wood items not indicated to receive shop-applied finish.
1. Latex System:
a. Prime Coat: Primer, latex for exterior wood.
1) S-W Exterior Latex Primer, B42, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, semi-gloss:
1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates:

1. Water-Based Light Industrial Coating System:
a. Prime Coat: Primer sealer, latex, interior:
1) S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based, eggshell:
1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

B. CMU Substrates in Locker and Shower Rooms

1. Water-Based Light Industrial Coating System:
    a. Block Filler: Block filler, latex, interior/exterior:
        1) S-W PrepRite Block Filler, B25W25, at 75-125 sq. ft. per gal. (1.84 to 3.07 sq. m per liter).
    b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    c. Topcoat: Light industrial coating, interior, water based, semi-gloss:
        1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

C. Glazed CMU Substrates:
    a. Prime Coat: Primer sealer, latex, interior:
        1) S-W Extreme Bond B51W00150, at 450-500 sg. Per gal.
    b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    c. Topcoat: Light industrial coating, interior, water based, eggshell:
        1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

D. Metal Substrates Aluminum, Steel, Galvanized Steel, Exposed to View Steel Structure .
    1. Water-Based Light Industrial Coating System:
        a. Prime Coat: Primer, rust-inhibitive, water based:
            1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
        b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
        c. Topcoat: Light industrial coating, interior, water based, semi-gloss:
            1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

E. Wood Substrates Opaque Finish: Including exposed wood items not indicated to receive shop-applied finish.
    1. Latex System:
        a. Prime Coat: Primer sealer, latex, interior:
            1) S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
        b. Intermediate Coat: Latex, interior, matching topcoat.
        c. Topcoat: Latex, interior, semi-gloss:
            1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.

F. Existing Wood Substrates in Multi-Purpose Room:
    1. Water-based clear topcoat over existing wood elements.
        a. Coat One: Minwax Polycrylic Crystal Clear Topcoat: Ultra flat finish
        b. Coat Two: Minwax Polycrylic Crystal Clear Topcoat: Ultra flat finish

G. Gypsum Wall Board: 2 Coats in strict accordance with manufacturer’s written instructions Gypsum Board Ceiling Substrates:
    1. Latex System:
        a. Prime Coat: Primer bonding, water-based.

1) S-W PrepRite ProBlock Latex Primer/Sealer, B57-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.

b. Intermediate Coat: Latex, exterior, matching topcoat.

c. Topcoat: Latex, exterior, low-sheen.

1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

H. Gypsum Board Wall Substrates: (In Locker Rooms, Showers and Toilet Rooms)

1. Water-Based Light Industrial Coating System

a. Prime Coat: Primer sealer, latex, interior:

1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based, eggshell:

1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

I. Gypsum Board Wall Substrates:

1. Latex System (Interior Conditions Spaces):

a. Prime Coat: Primer, latex, interior:

1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior, eggshell:

1) S-W ProMar 200 Zero VOC Latex Egg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.

END OF SECTION 09 91 000

SECTION 101416 – PLAQUES (MATERIAL ALLOWANCE)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes metal dedication plaque in lobby.

1.2 ALLOWANCES

A. Allowances for plaque material are specified in Section 012100 "Allowances."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For plaques.

1. Include fabrication and installation details and attachments to other work.
2. Show plaque mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each plaque at least half size.

C. Samples for Initial Selection: For each type of plaque, exposed component, and exposed finish.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For plaques to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of plaques 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.
   2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL PLAQUES

A. Cast Plaque: Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

   1. Manufacturers Providing Cast Plaques include, but are not limited to:
      a. A.R.K. Ramos
      b. ACE Sign Systems, Inc.
      c. Erie Landmark Company, A division of Paul Zimmerman Foundries, Inc.
      d. Gemini Signage, Gemini, Inc.
      e. Matthews International Corporation, Bronze Division
      f. Metallic Arts
      g. The Southwell Company
   2. Plaque Material: Cast bronze.
   3. Plaque Thickness: 0.50 inch (12.7 mm)].
   4. Finishes:
      a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
      b. Overcoat: Manufacturer's standard baked-on clear coating.

   5. Background Texture: As selected by Architect from manufacturer's full range.
   6. Integrally Cast Border Style: TBD
   7. Mounting: Concealed studs.
   8. Text and Typeface: TBD

2.2 MATERIALS

A. Bronze Castings: ASTM B584, alloy recommended by manufacturer and finisher for finish indicated.

2.3 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:
   1. Plaque Mounting Fasteners:

a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque unless otherwise indicated.

2.4 FABRICATION

A. General: Provide manufacturer's standard plaques according to requirements indicated.

B. Surface-Engraved Graphics: Machine-engrave characters and other graphic devices into indicated plaque surface to produce precisely formed copy, incised to uniform depth.

1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.

C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL PLAQUES

A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.

1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
   b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

3.3 ADJUSTING AND CLEANING

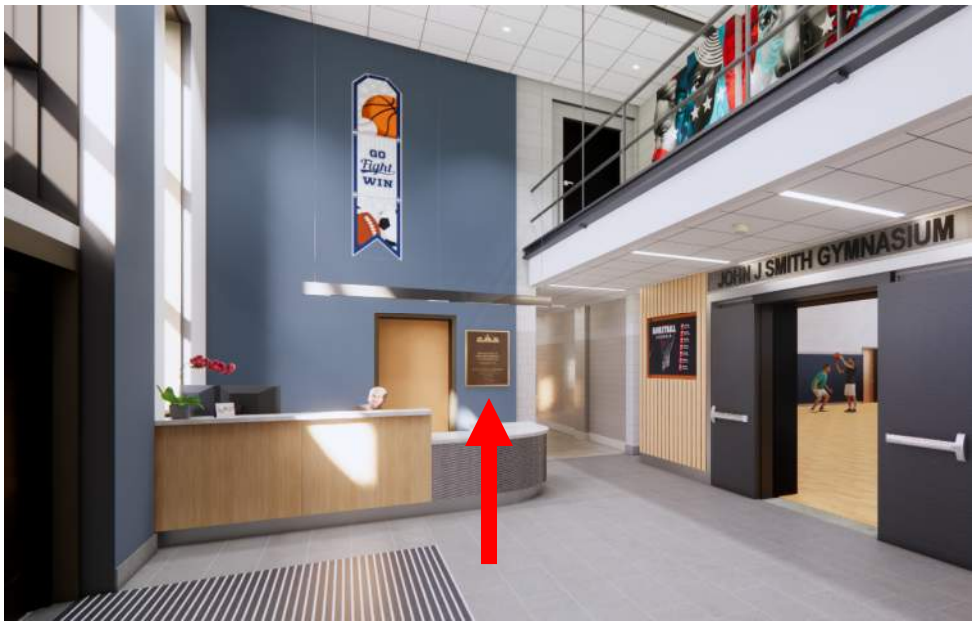
A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as plaques are installed.

C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

3.4 PROPOSED LOCATION

A.



END OF SECTION 101416

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Dimensional characters.
      a. Cast dimensional characters at Gymnasium entrance
      b. Final lettering to be determined by Owner

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signs.
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
   3. Show typestyles and layout of letters

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

   1. Dimensional Characters: Full-size Sample of a dimensional character.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five (5) years from date of Substantial Completion.

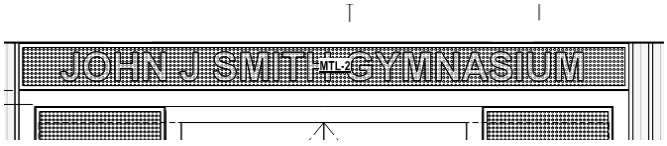
PART 2 - PRODUCTS

2.1 DIMENSIONAL CHARACTERS

A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, fabricated from one of the following manufacturers:
   1. A.R.K. Ramos
   2. Ace Sign Systems, Inc.
   3. ASI Sign Systems, Inc.
   4. Gemini Signage, Inc.
   5. Mathews International Corporation
   6. Metal Arts
   7. Metallic Arts
   8. Or approved equal

B. General Description
   1. Character Material: Cast aluminum.
   2. Character Height: As indicated on Drawings; approximately 8 inches.
   3. Thickness: ¾ inch.
   4. Finishes:
      a. Integral Aluminum Finish: Satin Directional Finish, Matte Edges
      b. Overcoat: Manufacturer's standard baked-on clear coating.
   5. Mounting: Projecting studs.
   6. Typeface: TBD

C. Final Lettering: Naming of Gymnasium to be determined by Owner. The following graphic on the drawing is a place holder to describe location, size, and number of letters.



2.2 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

2.3 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
   1. Exposed Metal-Fastener Components, General:
      a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
   2. Sign Mounting Fasteners:
      a. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

2.4 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
   1. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DIMENSIONAL CHARACTERS

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Mounting Methods:
1. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    a. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate and install washers and nuts on stud ends projecting through opposite side of surface and tighten.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes
   1. Room-identification signs that are directly attached to the building.
      a. Provide 1 sign for each room and space in the building.
   2. Life safety signage

1.2 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For room-identification signs.
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
   3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
   1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
   1. Room-Identification Signs: Full-size Sample.

E. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs 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.
      b. Deterioration of embedded graphic image.
      c. Separation or delamination of sheet materials and components.

PART 2 - PRODUCTS

2.1 ROOM-IDENTIFICATION SIGNS

A. Basis of Design Manufacturer – Raised, Melamine Plastic Signs “Graphic Blast MP
   1. Best Sign Systems, 1202 N. Park Ave., Montrose, CO 8140; Telephone 1-800-235-2378; Fax 1-970-249-0223; E-mail sales@bestsigns.com

B. Signs shall have the following characteristics:
   1. Tactile characters/symbols shall be raised 1/32 inch from sign plate face for ADA compliance.
   2. Signs shall be of one-piece construction; added-on and/or engraved characters are unacceptable
   3. unacceptable.
   4. Text on signs needing to comply with ADA shall be accompanied by Grade 2
   5. braille.
   6. All letters, numbers and/or symbols shall contrast with their background – either light characters on a dark background or dark characters on a light background
   7. Characters and background shall have matte finish.

2.2 Material

A. Sign material shall consist of melamine plastic approximately 1/8-inch-thick, with background painted a contrasting color.

B. Lettering font style shall be sans-serif and selected by Architect, upper case letters.

C. Sizes of letters and numbers shall be as follows:

1. Room numbers shall be 5/8" high
2. Lettering for room usage and directional identification shall be 5/8" high
3. Lettering for restroom identification shall be 5/8" high, corresponding symbols shall be 3" high

D. Sizes of letters and numbers shall comply with sample graphics indicated on the Drawings.

E. Letters and numbers shall be centered on sign.

F. Grade 2 braille shall be placed directly below last line of letters or numbers.

G. Corner Style, Square

H. Frame/Border: None

2.3 SIGN SIZE

A. Signage shall be proportionally sized based on the text and graphics, or as indicated in this Section or drawings.

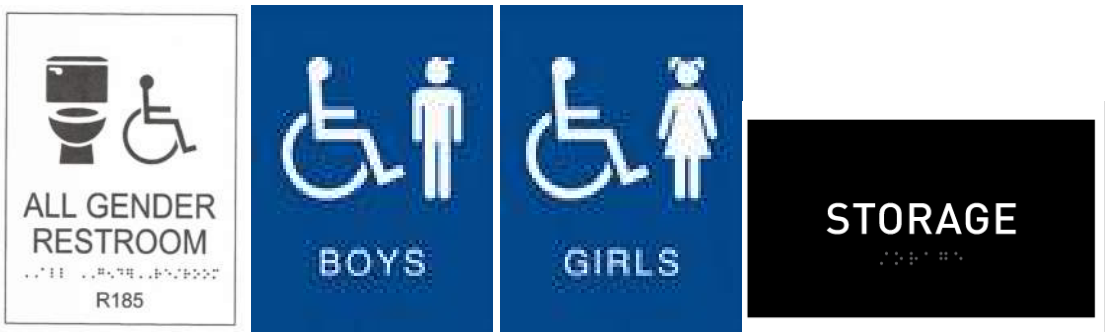
2.4 ROOM IDENTIFICATION SIGN SCHEDULE

A. Provide one sign for each room or space scheduled on the drawings including closets, corridors, storage spaces. Each sign shall have name, number and Type II Braille.

B. Coordinate Room Names and Numbers with fire alarm programming

C. Provide 6 no smoking signage with text, international symbol, and Type II Braille; locations to be determined in the field by the Architect and Owner.

D. Room Sign Examples Only:



2.5 LIFE SAFETY SIGNAGE

A. Life Safety Panel Signs: Custom Safety/Notice Panel Signs (Refer to Drawings for additional Panel sign types:

1. Roof Access Signage (Qty: 2)
   a. Size: Format for ¾ inch high minimum lettering; two colors

2. Access Signs: (Qty: 1)
   a. Size: Format for ¾ inch high minimum lettering; two colors

3. Building and Room Occupancy Signs, Building Entry, Multi-Purpose Room, and Gymnasium
   a. Size format 6 by 8 inches

4. Refer to drawings for individual room occupancy signs types at:
   1) Lounge/Meeting
   2) Computer Room

5. Sprinkler Access Sign
   a. 20 by 14 inches

6. Sprinkler Control Valves
   a. 20 by 11 inches

7. Bi-Directional Amplifier Controls
   a. Size 6 by 8 inches

2.6 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.

C. Mounting Methods:
1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

2.7 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid-plastic toilet compartments configured as toilet enclosures and urinal screens.

B. Related Requirements:
   1. Section 102800 "Toilet Accessories for toilet tissue dispensers, grab bars, and similar accessories mounted on toilet compartments.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings: For toilet compartments.
   1. Include plans, elevations, sections, details, and attachment details.
   2. Show locations of cutouts for compartment-mounted toilet accessories.
   3. Show locations of centerlines of toilet fixtures.
   4. Show locations of floor drains.

C. Samples for Initial Selection: For each type of toilet compartment material indicated.
   1. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
   1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
   2. Each type of hardware and accessory.

E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location, and selected colors for toilet compartment material.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and source.
   1. Door Hinges: Three (3) hinges with associated fasteners.
   2. Latch and Keeper: Three (3) with associated fasteners.
   3. Door Bumper: Three (3) with associated fasteners.
   4. Door Pull: Three (3) with associated fasteners.
   5. Fasteners: Twelve (12) fasteners of each size and type.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and the Massachusetts Architectural Access Board Regulations for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

A. Toilet compartments: Flush type, floor mounted, overhead braced, of standard height and depth, except for sizes of handicapped compartments, which shall be as indicated on the Drawings. Acceptable models are the following, or approved equal:
   1. AJW Architectural Products.
   2. Ampco by AJW.
   3. ASI Accurate Partitions, an ASI Group company.
   4. ASI Global Partitions, an ASI Group company.
   5. Accurate Partitions Corp.
   6. General Partitions Manufacturing Corp.
   7. Global Partitions
   8. Hadrian Inc., Mentor OH.
   9. Metpar Corporation,
   10. Scranton Products

B. Toilet-Enclosure Style: Floor anchored/overhead braced

C. Urinal-Screen Style: Floor mounted post

D. Door Height Above Floor: 14 inches (305 mm).

E. Door Panel Height: 55 inches (1473 mm).

F. Pilaster Height: 82 inches (1626 mm).

G. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, and integral no-sightline privacy system including profile on strike and hinge side that overlaps adjacent pilaster with homogenous color and pattern throughout thickness of material.

1. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-HDPE components to hinder malicious combustion.
2. Finish Texture: Pebble Grained
3. Color and Pattern: Two colors and patterns as selected by Architect from manufacturer's full range.

H. Pilaster Shoes: Stainless steel sheet, not less than 0.031 inch (0.79 mm) nominal thickness and 3 inches (76 mm) high, with No. 4 satin finish. Shoe bottom enclosed and integral to compartment structure. Secure to floor with manufacturer's recommended concrete anchors.

I. Brackets (Fittings):
1. Full-Height (Continuous) Type: Manufacturer's standard design; extruded aluminum.

J. Urinal screens: Flush type, 42 inch high, 18 inches deep matching construction and finish of toilet partitions with continuous wall hung channel support.
1. Urinal Screens shall be provided by Toilet Compartment Manufacturer.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch- (1.59-mm-) thick stainless-steel continuous, spring-loaded type, allowing emergency access by lifting door. Mount with through-bolts.
2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.
5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
6. Stirrup Type: Ear or U-brackets.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with anti-grip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
1. Maximum Clearances:
   a. Pilasters and Panels: 1/2 inch (13 mm).
   b. Panels and Walls: 1 inch (25 mm).
2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.

b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with at least 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.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 102113.19

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SECTION 102239 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manually operated, acoustical panel partitions.

B. Related Requirements:

   1. overhead structural system.
   2. Section 092900 "Gypsum Board" for sound barrier construction above the ceiling at track.

1.2 DEFINITIONS

A. NIC: Noise Isolation Class.

B. NRC: Noise Reduction Coefficient.

C. STC: Sound Transmission Class.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For operable panel partitions.
   1. Include plans, elevations, sections, attachment details, and numbered panel installation sequence.
   2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.

C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.
   1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:

   1. Textile Facing Material: 12 by 12 inch section of fabric from dye lot to be used for the Work, with specified treatment applied. Show complete pattern repeat.
   2. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches (75 mm) square.

3. Panel Edge Material: Not less than 3 inches (75 mm) long.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Partition track, track supports and bracing, turning space, and storage layout.
   2. Suspended ceiling components.

B. Qualification Data: For Installer.

C. Product Certificates: For each type of operable panel partition.

D. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.

E. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
      b. Seals, hardware, track, track switches, carriers, and other operating components.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Faulty operation of operable panel partitions.
      b. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties in accordance with test methods indicated:

B. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance in accordance with ASTM E90, determined by ASTM E413, and rated for not less than the STC indicated.

C. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance in accordance with ASTM C423, and rated for not less than the NRC indicated.

D. Noise-Isolation Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC in accordance with ASTM E336, determined by ASTM E413, and rated for 10 dB less than STC value indicated.

E. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction:
   1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.

2.2 AVAILABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide basis-of-design products indicated by Modernfold, Inc. or comparable products by one of the following:

   1. Hufcor, Inc.
   2. KWIK-WALL Company.
   3. Or approved equal

2.3 OPERABLE ACOUSTICAL PANELS

A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Modernfold, Inc.; Acousti-Seal Legacy Paired Panel ((32) or comparable product.

B. Panel Operation: Manually operated, paired panels.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
1. Panel Width: As indicated on drawings.

E. STC: Not less than: 52.

F. Panel Weight: 6 lb/sq. ft. to 11 lb/sq. ft. maximum.

G. Panel Height: As indicated

H. Panel Thickness: Nominal dimension of 3 inches.

I. Panel Materials:
1. Steel Frame: Steel sheet, 0.0635-inch (1.61-mm) nominal minimum thickness for uncoated steel.

J. Panel Edge: Roll formed 16 gage steel wrapped.
1. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard thickness required based on STC and partition performance requirements.

K. Panel Closure: Manufacturer's standard unless otherwise indicated.

L. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
1. Hinges for Closure Panels, Pass Doors, and Pocket Doors: Full leaf butt hinge, concealed (invisible).
2. Hardware Finish: Natural Choice.

M. Finish Facing: Fabric wall covering, stain resistant. Architect to select from full range Modernfold Standard Maharam® Fabric.

2.4 SEALS

A. Description: Seals that produce operable panel partitions complying with performance requirements and the following:
   1. Manufacturer's standard seals unless otherwise indicated.
   2. Seals made from materials and in profiles that minimize sound leakage.
   3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.

B. Vertical Seals: Deep-nesting, interlocking steel astragals mounted on each edge of panel, with continuous, resilient acoustical seal.

C. Horizontal Top Seals: Automatic continuous-contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers.

D. Horizontal Bottom Seals: Manufacturer's standard continuous-contact seal exerting uniform constant pressure on floor.

E. Horizontal Bottom Seals: Resilient, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
   1. Automatically Operated for Acoustical Panels: Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than 2 inches (50 mm) between retracted seal and floor finish.
      a. Basis-of-Design: Modernfold, Inc.; A2 - Automatic operable seals.

2.5 SUSPENSION SYSTEMS

A. Tracks: Steel mounted with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch (2.54 mm) between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
   1. Basis of Design Product: Subject to compliance with requirements provide Modernfold, Inc.; #14 - Smart Track or comparable product.
      a. Exposed Track Soffit: Steel, integral to track, prepainted Off-White finish.

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

C. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

2.6 ACCESSORIES

A. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with

operating hardware and acoustical seals at soffit, floor, and jambs.. Hinges in finish to match other exposed hardware.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Modernfold, Inc.; Acousti-Seal pocket door or a comparable product.

    a. Pocket Door Configuration: Manually operated, Type II, double door hinged to a jamb on each side and closing in the center. One of the door panels is equipped with a smaller hinged panel that folds back when the operable partition is extended into the pocket.

2. Lock: Key-operated lock cylinder, keyed to master key system, to secure storage pocket door in closed position. Include two keys per lock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flooring, floor levelness, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

B. Install panels in numbered sequence indicated on Shop Drawings.

C. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

D. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

3.3 ADJUSTING

A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust storage pocket doors to operate smoothly and easily, without binding or warping.

3.4 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service to include twelve [12] months' full maintenance by manufacturer's authorized service representative.

Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operable-partition operation. Parts and supplies to be manufacturer's authorized replacement parts and supplies.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 102239

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SECTION 102813 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Toilet accessories

B. Products furnished by this Section installed by others”
   1. Warm Air Dryers installed by Section 260000 Electrical

C. RELATED SECTIONS
   1. Section 10 21 13.19 – Plastic Toilet Compartments mounting of toilet tissue dispensers, grab bars, purse shelves, and similar accessories.
   2. Section 220000-Plumbing for shower accessories that are integral to shower unit

1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Include electrical characteristics.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated.
   2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty for Washroom Accessories: Manufacturer's standard 1 year warranty for materials and workmanship.

B. Manufacturer's Warranty for Electric Hand Dryers: Manufacturer's standard 5 year warranty on parts, except 3 year warranty on motor brushes from date of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering accessories that may be incorporated into the Work include, but are not limited to, the following:
   1. Toilet Accessories:
      a. Bobrick Washroom Equipment, Inc. (Basis of Design)
      b. Bradley Corporation.
      c. World Dryer, www.worlddrryer.com is an acceptable manufacturer for hand dryers
      d. Or approved equal

B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to those indicated in the Toilet and Bath Accessory Schedule at the end of Part 3.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units' level, plumb, and firmly anchored in locations and at heights indicated.
   1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

3.3 TOILET ACCESSORY SCHEDULE

A. TBA-1A Mirror Custom
1. Basis-of-Design: Bobrick 2436
2. Frameless, Stainless Steel Mirrors:
3. Size: 23-1/2 inches (597mm) W x 35-1/2 inches H.
4. Mirror: 18-8, Type 304, 20 Gauge (0.9mm) stainless steel polished to a No. 8 mirror finish, 1/4-inch (6 mm) return. Four corner countersunk holes to provide flush fit of mounting screws with mirror surface.
5. Backing: 1/4 inch (6mm) thick tempered Masonite.
6. Mounting Hardware: Four countersunk sheet metal screws included with unit.

B. TBA—1B Mirror
1. Basis-of-Design: Bobrick 2460
2. Frameless, Stainless Steel Mirrors:
3. Size: 23-1/2 inches (597mm) W x 59-1/2 inches (902mm) H.
4. Mirror: 18-8, Type 304, 20 Gauge (0.9mm) stainless steel polished to a No. 8 mirror finish, 1/4-inch (6 mm) return. Four corner countersunk holes to provide flush fit of mounting screws with mirror surface.
5. Backing: 1/4 inch (6mm) thick tempered Masonite.
6. Mounting Hardware: Four countersunk sheet metal screws included with unit.

C. TBA-2 Toilet Paper Dispenser
1. Basis of Design: Bobrick Classic Series Model B-2740.
2. Towel Dispensing: No controlled delivery.
3. Bracket: Heavy-duty cast aluminum with satin finish.
4. Spindle: Molded high-impact ABS plastic; equipped with retractable pin and concealed locking mechanism.
5. Capacity: Accommodates standard core toilet tissue rolls up to 6 inch (152mm) diameter (2000 sheets).

D. TBA-3 Trash Receptacle
1. Recessed Mounted Waste Receptacles:
2. Basis of Design: Bobrick Trim Line Model B-35639.
3. Description: Door conceals flange from view.
4. Cabinet: 18-8, Type 304, heavy-gauge stainless steel. All-welded construction.
5. Door: 18-8, Type 304, 18 gauge (1.2mm) stainless steel with satin finish; 3/4 inch (19mm) 90 degree return edges; Secured to cabinet with a concealed, full-length stainless steel piano-hinge. Equipped with a stainless steel cable door-swing limiter and one tumbler lock keyed like other Bobrick washroom accessories. Self-closing push door mounted on continuous stainless steel piano hinge.
6. Disposal Door: 18-8, Type 304, heavy-gauge stainless steel with satin finish. Secured to cabinet with spring-loaded, full length stainless steel piano hinge. Equipped with International graphic symbol identifying waste disposal.
7. Receptacle: 18-8, Type 304, heavy gauge stainless steel. All-welded construction. Removable for servicing. Capacity: 3 gallons (11.3 L).

E. TBA- 4 Soap Dispenser
   1. Basis of Design: B-2111 Classic Series Wall-Mounted Soap Dispenser.
   2. Vertical tank is satin-finish stainless steel.
   3. Valve dispenses all-purpose hand soaps.
   4. Capacity: 40-fl oz (1.2-L).
   5. Soap refill window.
   6. Concealed wall fastening.
   7. Hinged filler-top requires special key to open.
   8. Vandal resistant.
   9. Unit 4 3/4" W, 8 1/8" H (120 x 205mm); wall to push-button, 3 1/2" (90 degree m).

F. TBA-5 Sanitary Napkin Disposal Unit: Where this designation is indicated, provide unit serving two toilet compartments complying with the following:
   1. WALL AND PARTITION MOUNTED : As follows:
      a. Basis-of-Design Product: Bobrick B-5270 “Matrix Series” or approved equal.
      b. Mounting: Back to Back through partition
      c. Material: Stainless steel.
      d. Door or Cover: Self-closing.

G. TBA-6; Grab Bar Toilets: Where this designation is indicated, provide stainless-steel grab bar complying with the following:
   1. Products: Bobrick model B.6806 x 42 inch or approved equal.
   2. Material: Stainless-Steel Nominal Thickness: 18 gage
   3. Mounting: Concealed with manufacturer's standard flanges and anchors
   4. Gripping Surfaces: Manufacturer's standard slip-resistant "peened" texture
   5. Outside Diameter: 1-1/2 inches (38 mm) for heavy-duty applications

H. TBA-7- Electric Hand Dryer
   1. Basis of Design: Bobrick Trim Dry Model B-7128 115V.
   2. Cover: 22-gauge galvanized steel with exposed surface, Type 304 stainless steel with vertical grain No. 4 satin finish.
   3. Power: 115V AC, 15 amp, 1725 watts, 50/60 Hz, single phase, cULus Listed.

I. TBA-8 Shower Curtain Rods With Concealed Mounting:
   1. Basis of Design: Bobrick Model B-207 x 36.
   2. Basis of Design: Bobrick Model B-207 x 72.
   3. Length: 72 inch (1830mm).
   4. Curtain Rod: 18-8, Type 304, 20 gauge (1.0mm) stainless steel tubing with satin finish.
   5. Outside Diameter: 1 inch (25mm).

J. TBA-9A- Hook Strip
   1. Basis of Design: Bradley SA41- Security Tension Towel Hook Strip
   2. Towel Hook Strip for Security applications is surface mounted and includes 4 breakaway hooks.
   3. Hooks will release item when 20 lbs. of force or more is applied.
   4. Unit is made from satin finish stainless steel
   5. Front mounted

K. TBA-9B- Hook-Single
   1. Basis of Design: Bradley SA35- Security Tension Towel Hook Strip

2. Towel Hook Strip for Security applications is surface mounted and includes 1 breakaway hooks.
3. Hooks will release item when 20 lbs. of force or more is applied.
4. Unit is made from satin finish stainless steel
5. Front mounted

L. TBA-10 Shelf
1. Basis of Design: Bradley 9094-18
2. Surface-Mounted - Concealed Mounting
3. Stainless Steel- satin finish
4. Vandal-Resistant Escutcheons
5. 5" Deep
6. Size: 18-inch.

END OF SECTION 102813

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SECTION 105126 – PLASTIC LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Provide solid plastic lockers.
   1. 2 tier lockers

B. Provide designated Accessible markings with International Symbol permanently located on the locker door.

C. Related work:
   1. Section 033000- Cast-In-Place Concrete for Concrete Curb supporting lockers.

1.3 REFERENCES

A. ASTM International (ASTM):
   1. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.
   2. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. Government:
   1. Rhode Island Accessibility Code based on (ICC) A117.1 2017
   2. U.S. Architectural & Transportation Barriers Compliance Board. Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG).

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets for each type of product indicated include fabrication details, description of materials and finishes.

B. Shop Drawings: Include overall locker dimensions, floor plan, elevations, sections, details, and attachments to other work. Include choice of options with details.

C. Samples for Selection: Furnish samples of manufacturer's full range of colors for initial selection.

D. Samples for Approval: Furnish a physical sample of the material in the selected color.

   1. Size: 6 by 6 inch (102 by 102 mm) in type of finish specified.

1.5 INFORMATIONAL SUBMITTALS

A. Installation instructions.

B. Warranty: Sample of special warranty.

1.6 MAINTENANCE SUBMITTALS

A. Operation and Maintenance Data.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Approved manufacturer listed in this section, with minimum 5 years' experience in the manufacture of plastic lockers.

B. Installers Qualifications: An experienced Installer regularly engaged in the installation of lockers for a minimum of 3 years.

C. Source Limitations: Obtain plastic lockers and trim accessories from single manufacturer.

D. Accessibility Requirements: Comply with requirements of MAAB, ADA/ABA and with requirements of authorities having jurisdiction.

E. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 100 or less.
2. Smoke-Developed Index: 450 or less.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver plastic lockers to the site until the building is enclosed and HVAC systems are in operation. Deliver plastic lockers in manufacturer's original packaging. Store in an upright condition. Protect plastic lockers from exposure to direct sunlight.

B. Ship plastic lockers fully assembled.

C. Lift and handle plastic lockers from the base not the sides.

1.9 WARRANTY

A. Special Manufacturer's Warranty: 20 year against rust, delamination or breakage of plastic parts under normal use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products of Bradley Corporation, Lenox Locker Standard, www.bradleycorp.com.

B.

C. Other manufacturers providing project that can meet the requirements include, but are not limited to:
   1. Scranton Products Tufftec Lockers https://www.scrantonproducts.com/
   2. Or approved equal

D. MATERIALS

   1. High Density Polyethylene (HDPE): 30 percent pre-consumer recycled content polyethylene thermoplastic formed under high pressure into solid plastic components.
   2. Stainless-Steel Sheet: ASTM A 666, Type 304.
   3. Fasteners: Tamper-Resistant Fasteners: Stainless steel torx-head screws.
      a. Locker Connectors: No. 10-24 sex bolts.
      b. Anchors: Type and size required for secure anchorage.
      c. Drilled-in-place Masonry Anchors: Minimum 1/4 by 1-3/4-inch (6 by 44 mm) screws.

2.2 STANDARD PLASTIC LOCKERS

A. Locker Configuration: 2 Tier.

B. Locker Dimensions
   1. Height, Nominal: 72 inch (1829 mm) overall.
   2. Width:
      a. 12 inches
   3. Depth:
      a. 12 inches

C. Material: HDPE plastic.

D. Sides, Tops, Bottoms, Dividers, and Shelves: 3/8 inch (10 mm) thick HDPE plastic with smooth finish.

E. Locker Tops: Flat top. Top shall extend wall to wall and close gap above end filler panels and corner void space.

F. Doors: Fabricate from a single piece 1/2-inch (13 mm) HDPE plastic.
   1. Doors and Frame: 1/2 inch (13 mm) thick HDPE plastic with matte texture finish with ventilation slots.
   2. Handle: ADA/ABA Compliant handle fabricated from injection molded plastic.
   3. Locks: Standard hasp**.**
   4. Hinges: Continuous piano hinges, .05 inch/18 gauge (1.27 mm) thick type 304 stainless steel fabricated to wrap around edges of door and frame and attached with stainless steel tamper-resistant screws.
      a. Finish: Powder coated to match color of locker.

   5. Latch Bar: Full-height latch bar constructed of 1/2-inch (13 mm) HDPE plastic secured to locker with stainless steel tamper-resistant screws.

G. Color: As selected by Architect from manufacturer's full range.

1. Lockers will include two colors, including two colors in one group of lockers.

H. Accessories:

1. Coat Hooks: Black polycarbonate double hook.
2. End Panels: 3/8 inch (10 mm) thick, with color and finish matching locker body.
3. Filler Panels: 1/2-inch (13 mm) HDPE filler panel, with color and finish matching locker body, attached with 3/8 inch (10 mm) thick HDPE solid plastic angle bracket.
4. Number Plate: White acrylic with black film coating, laser etched with number specified. Provide one per locker.
5. Accessible symbol on accessible units.
6. Locker Base: Concrete base as shown on drawings

2.3 LOCKER FABRICATION

A. Fabricate locker box from a single sheet of HDPE solid plastic with corners fused together. Weld frames and shelves to box assembly. Provide all welded construction of locker parts without dovetail slots or metal fasteners. Add welded gussets in single tier full height lockers.

B. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

C. Hardware Attachment: All hinges, handles, hasps, hooks, latch bars, and locks attached with tamper-resistant screws.

D. Provide ventilated panels where indicated.

E. Filler Panels: Fabricated in unequal leg angle shape; finished to match lockers.

F. Finished End Panels: Fabricated with 3/8 inch (10 mm)**]**wide edge dimension, configured to conceal fasteners and holes at exposed ends of plastic lockers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lockers in climate-controlled environment, shielded from direct sunlight.

B. General: Install on floor or other firm support. Install level, plumb, and true.
1. Attach filler pieces to lockers with male-female sex bolts.
2. Position first locker according to submittal layout. Square and plumb the locker using concealed shims. Secure the locker to the wall at the top and bottom of the locker. Position second locker next to first, square and plumb to align the tops and bottoms; and temporarily clamp lockers together. Drill four holes through the sides of the lockers and connect lockers using sex bolts provided by manufacturer.

C. Accessories: Fit exposed connections of trim, fillers, and closures together to form tight, hairline joints, with concealed fasteners and splice plates furnished by locker manufacturer. Install as indicated on approved shop drawings.

1. Coat Hooks: Attach with at least two fasteners.
2. Identification Plates: Identify plastic lockers with approved identification numbers. Attach plates to each locker door.
3. Filler Panels: Attach with concealed fasteners.
4. Finished End Panels: Attach at ends indicated.
5. Secure flat top filler at wall and corner void.

3.2 FINAL CLEANING

A. Clean locker interior and exterior surfaces.

B. Remove packaging and construction debris and legally dispose of off-site.

END OF SECTION 105126

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SECTION 115213 - PROJECTION SCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Electrically operated, front-projection screens.

B. Related Requirements:
   1. Section 061000 "Rough Carpentry" for wood backing for screen installation.

1.2 DEFINITIONS

A. ALR: Ambient-light rejection; for specular reflective viewing surfaces, measured as the percentage of ambient light striking the viewing surface that has equal angles of incidence and reflection.

B. Gain: Ratio of light reflected from viewing-surface material to that reflected perpendicularly from a magnesium carbonate surface as determined in accordance with SMPTE RP 94.

C. Half-Gain Angle: The angle, measured from the axis of the viewing surface to the most central position on a perpendicular plane through the horizontal centerline of the viewing surface, where the gain is half of the peak gain.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show layouts and types of front-projection screens. Include the following:
   1. Drop heights.
   2. For end-mounted motors, location of screen centerline relative to ends of screen case.
   3. Anchorage details, including connection to supporting structure for suspended units.
   4. Details of juncture of screen case or trim with adjacent finishes.
   5. For electrically operated units, wiring diagrams and location of wiring connections.
   6. Accessories.

C. Samples: For each type of exposed finish and for each color and finish specified, in manufacturer's standard sizes.

D. Samples for Initial Selection: For each type of exposed finish.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For front-projection screens to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Environmental Limitations: Do not deliver front-projection screens until spaces are enclosed and weathertight, wet-work in installation spaces is complete and dry, and temporary or permanent HVAC system is operating and maintaining ambient temperature and humidity conditions planned for building occupants during the remainder of the construction period.

B. Store front-projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

1.6 COORDINATION

A. Coordinate layout and installation of front-projection screens with adjacent construction, including ceiling suspension systems, light fixtures, HVAC system components,[fire-suppression system,] and partitions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Projection Screens: Obtain front-projection screens from single manufacturer. Obtain viewing surfaces and accessories, including mounting hardware, from screen manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Viewing-Surface and Masking Materials:

1. Mildew-Resistance Rating: Zero or 1 when tested in accordance with ASTM G21.
2. Flame Resistance: Passes NFPA 701.
3. Flame-Spread Index: Not greater than 75 when tested in accordance with ASTM E84.

2.3 ELECTRICALLY OPERATED, FRONT-PROJECTION SCREENS

A. General Requirements: Manufacturer's standard units, consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by Underwriters Laboratories Inc. (UL) or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. 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.
2. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a metal rod, with ends of rod protected by plastic caps.

B. Surface-Mounted, Metal-Encased, Electrically Operated Screen Motor-in-roller unit with screen case fabricated from formed-steel sheet or from aluminum extrusions with manufacturer's standard finish and matching end caps.

C. Basis of Design: Acceptable Manufacturer: Draper, Inc., which is located at: 411 S. Pearl P. O. Box 425; Spiceland, IN 47385-0425. ASD. Toll Free Tel: 800-238-7999; Tel: 765-987-7999; Fax: 866-637-5611; Web: www.draperinc.com.
   1. Targa XL: Electric motor operated, metal case. Cases consist of a curved front and L-shaped back/top cover fabricated of extruded aluminum, with endcaps forming ceiling hanging bracket. Case size 6-3/4 inches high x 6-3/4 inches deep (172 mm high x 172 mm deep). White scratch resistant textured finish.
   2. Motor UL certified, rated 110-120V AC, 60 Hz, three wire, instantly reversible, lifetime lubricated with pre-set accessible limit switches.
   3. Wall Mounting Bracket Kit: Kit includes two structural steel brackets and hardware to attach brackets to case. Hardware for mounting to wall structure by others

D. Projection Viewing Surface: Matt White XT1000E – On Axis gain of 1.0. 180 degree viewing cone. Washable surface. GREENGUARD Gold certified. 4K ready.

E. Viewing Area H &W
   1. 16:10 Format. Black masking borders standard.
      a. 198 inch (5029 mm) diagonal, 105 inches x 168 inches (2667 mm x 4267 mm).

F. Surface-Mounting Configuration: Mounted using manufacturer's standard projecting wall brackets

G. Screen-Case Color: As selected by Architect from manufacturer's standard options.

2.4 FRONT PROJECTION SCREEN CONTROLS

A. General: All controls are UL Certified.
   1. Key operated 3-position control switch rated 115V AC, 60 Hz to stop or reverse screen at any point.
   2. Motor shall be left mounted (standard).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install front-projection screens at locations indicated on Drawings to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor them to supporting substrate in a manner that produces a smoothly operating screen that, when lowered, has flat viewing surface and plumb vertical edges.

1. Wiring Method: Install wiring in raceway, except in accessible ceiling spaces and in gypsum board partitions, where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables, except in unfinished spaces.

C. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.

END OF SECTION 115213

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Manually operated roller shades with single and double rollers.

B. Related Requirements:
   1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shade band materials, their orientation to rollers, and their seam and batten locations.

C. Samples: For each exposed product and for each color and texture specified, 10 inches (250 mm) long.

D. Samples for Selection: For each type and color of shade band material.
   1. Include Samples of accessories involving color selection.

E. Product Schedule: For roller shades located by Room and Window Type

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shade band material.

C. Product Test Reports: For each type of shade band material, for tests performed by manufacturer and witnessed by a qualified testing agency..

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Draper Inc.; Manual FlexStyle or a comparable product by one of the following:
   1. Hunter Douglas Contract.
   2. MechoShade Systems, Inc.
   3. Or approved equal.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
   1. Bead Chains: Nickel-plated metal.
      a. Loop Length: Full length of roller shade
      b. Limit Stops: Provide upper and lower ball stops.
      c. Chain-Retainer Type: Clip, jamb mount.

2. Breakaway Chain: Chain shall comply with the requirements of Rhode Island window treatment chord requirements, passed into law in June 2024, to prevent strangulation.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shade bands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shade bands for service.
1. Roller Drive-End Location: Right side of interior face of shade.
2. Direction of Shade band Roll: Regular, from back (exterior face) of roller.
3. Shade band-to-Roller Attachment: Manufacturer's standard method.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Shade bands:
1. Shade band Material: Light-filtering fabric.
a. Basis of Design: Draper E Screen 3% ATF
b. Shade band Bottom (Hem) Bar: Steel or extruded aluminum.
c. Type: Enclosed in sealed pocket of shade band material.
d. Color and Finish: As selected by Architect from manufacturer's full range

F. Installation Accessories:
1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shade band assembly when shade is fully open, but not less than 4 inches (102 mm).

2. Exposed Headbox at Surface Mounted Roller Shades Only: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
a. Height: Manufacturer's standard height required to enclose roller and shade band assembly when shade is fully open, but not less than 4 inches (102 mm).

3. Endcap Covers: To cover exposed endcaps.

2.3 MANUALLY OPERATED SHADES WITH DOUBLE ROLLERS AT MULTI-PURPOSE ROOM

A. Basis-of-Design Product: Subject to compliance with requirements, provide Draper Inc.; Dual Roller Flex Shade or a comparable product by one of the following:
1. Hunter Douglas Contract.
2. MechoShade Systems, Inc.
3. Or approved equal

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Nickel-plated metal.
   a. Loop Length: Full length of roller shade
   b. Limit Stops: Provide upper and lower ball stops.
   c. Chain-Retainer Type: Clip, jamb mount.
2. Breakaway Chain: Chain shall comply with the requirements of Rhode Island window treatment chord requirements, passed into law in June 2024, to prevent strangulation.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shade bands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shade bands for service.
1. Dual-Roller Mounting Configuration: Offset, outside roller over and inside roller under.
2. Inside Roller:
   a. Drive-End Location: Right side of interior face of shade.
   b. Direction of Shade band Roll: Regular, from back (exterior face)
3. Outside Roller:
   a. Drive-End Location: [Left side of interior face of shade.
   b. Direction of Shade band Roll: Regular, from back (exterior face)
4. Shade band-to-Roller Attachment: Manufacturer's standard method.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

E. Inside Shade bands:

1. Shade band Material: Light-filtering fabric
   a. Basis of Design: Draper E Screen 3% ATF
2. Shade band Bottom (Hem) Bar: Steel or extruded aluminum.
   a. Type: Enclosed in sealed pocket of shade band material.
   b. Color and Finish: As selected by Architect from manufacturer's full rage..

F. Outside Shade bands:
1. Shade band Material: Light-blocking fabric
   a. Basis of Design: Draper Flocke
2. Shade band Bottom (Hem) Bar: Steel or extruded aluminum.
   a. Type: Enclosed in sealed pocket of shade band material.
   b. Color and Finish: As selected by Architect from manufacturer's full range.

G. Installation Accessories:
1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
   a. Shape: L-shaped.
   b. Height: Manufacturer's standard height required to conceal roller and shade band assembly when shade is fully open, but not less than 7 inches (178 mm).

2.4 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less than 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shade band Fabrication: Fabricate shade bands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shade band is equal to or greater than 1:4, provide battens and seams at uniform spacings along shade band length to ensure shade band tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shade bands: Located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Roller Shade Locations: As indicated in window-covering schedule.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 123661.16 SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Solid surface material countertops.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
   1. Show locations and details of joints.
   2. Show direction of directional pattern, if any.

C. Samples for Initial Selection: For each type of material exposed to view.

D. Samples for Verification: For the following products:
   1. Countertop material, 6 inches (150 mm) square.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Avonite Surfaces.
      b. E. I. du Pont de Nemours and Company.
      c. Formica Corporation.
   2. Type: Provide Standard type
   3. Colors and Patterns: As selected by Architect from manufacturer's full range.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

C. Seale underside of plywood with 2 coats of water-based polyurethane.

2.2 ANGLE SUPPORT FOR COUNTERS

A. Wall mounted support brackets equal to Rakks or equal
   1. Rangine Corporation, 330 Reservoir Street, Needham, Massachusetts 02494; 800-826-6006; www.rakks.com.
   2. Material: Fabricate components from extruded aluminum sections complying with ASTM B221, 6063-T5 alloy and temper.
   3. Factory applied finishes: Exposed aluminum surfaces shall be free of scratches and other serious blemishes and be factory finished with clear anodized coating complying with AAMA 607.1 - MM10C22A31.
   4. Size Counter: Provide Surface Mount EH Counter Support Brackets with Rounded Ends sized for counter depth:
      a. Standard size with rounded ends to meet counter depth.
      b. Brackets at no more than 24 inches O.C.

2.3 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
   1. Grade: Custom.

B. Configuration:
   1. Front: Straight, slightly eased at top
   2. Backsplash: Straight, slightly eased at corner.
   3. End Splash: Matching backsplash

C. Countertops: 3/4-inch- (19-mm-)] thick, solid surface material with front edge built up with same material.

D. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material.

E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

F. Joints: Fabricate countertops without joints.

G. Cutouts and Holes:
   1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
      a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.
   2. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.4 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten sub-tops to cabinets by screwing through sub-tops into corner blocks of base cabinets. Shim as needed to align sub-tops in a level plane.

D. Secure countertops to sub-tops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

G. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Roll-up rail mats.
   2. Recessed

1.3 COORDINATION

A. Coordinate size and location of recesses with tile installation specified in Section 093300 Tiling

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.

B. Shop Drawings:
   1. Items penetrating floor mats and frames, including door control devices.
   2. Divisions between mat sections.

C. Samples: For the following products, in manufacturer's standard sizes:
   1. Floor Mat: Assembled sections of floor mat.
   2. Tread Rail: Sample of each type and color.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

A. Structural Performance: Provide roll-up rail mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:

1. Maximum static load: 200 kg/cm²
2. Wheel load of 200 kg.

B. Accessibility Standard: Comply with applicable provisions in ICC A117.1.

2.2 ROLL-UP RAIL MATS

A. Basis of Design Mat is Forbo Nuway Tuftiguard Classic.

B. Other Manufacturers making products that meet the requirements of this Section include:
1. Matter Surfaces
2. Balco FM2S-C
3. JL Industries

C. Roll-up, Aluminum-Rail Hinged Mats: Extruded-aluminum tread rails 22 mm wide by 10 mmm thick, sitting on continuous vinyl cushions.
1. Scraper Bar: Two (2) open wiper strips 12 mm high
2. Wiper Bar: equal to unbuffed classic.
3. Colors, Textures, and Patterns of Inserts: As selected by Architect from full range of industry colors

2.3 FRAMES

A. Recessed Frames: Manufacturer's standard extrusion.
1. Extruded Aluminum: ASTM B221 (ASTM B221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
a. Color: Mill finish

2.4 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

B. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.

1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install recessed mat frames and mats to comply with manufacturer's written instructions so that tops of mats will be flush with adjoining finished flooring. Set mats with tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.

3.3 PROTECTION

A. 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.

END OF SECTION 124813

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SECTION 210000 - FIRE PROTECTION

PART 1 GENERAL

1.1 GENERAL PROVISIONS

A. Consult in detail all other sections relative to the work, including bidding requirements, contract forms, general conditions, supplementary conditions and division 1 general requirements. Scope of work

1.2 SCOPE OF WORK

A. The work under this section includes, but is not limited to, following:

1. A complete hydraulically designed sprinkler system in accordance with NFPA 13 for all areas of the building, commencing at the service provided by the general contractor. The system shall be designated as a wet pipe system in accordance with the contract documents.
2. Preparation of sprinkler plans (i.e. shop drawings) and hydraulic calculations and having the plans and calculations stamped by a registered fire protection engineer.
3. Submittal of hydraulic calculations and drawings to the owner's underwriter, the local fire department and the architect for approval.
4. Obtain all permits and approvals required for work under this section.
5. Setting of all sleeves for the installation of all piping under this section of the specification.
6. All drilling of holes for piping, including but not limited to steel, concrete, and wood coring. Patching to be performed by others.
7. All cutting of structure for installation of piping and equipment, patching by others. Work by others

1.3 WORK BY OTHERS

A. The following items and associated work involved will be performed under other Divisions and/or Sections:

1. Cutting and patching
2. Finished painting
3. Building heating system
4. Building plumbing system
5. Water service
6. Electrical

1.4 GENERAL REQUIREMENTS

A. Submittals

1. Submit for approval within 30 days of the date of the contract, a list of manufacturers of material and equipment that are to be used under this section of the specifications. After approval of the list, shop drawings, including complete specifications of capacity and requirements of equipment, shall be submitted for approval. Equipment shall be of proper size for its allotted space if make of equipment other than that specified is used.
2. No part of the work shall be started in the shop or in the field until the engineer has reviewed and approved the shop drawings.
3. Submission of shop drawings shall be construed as evidence that a careful examination of the plans has been made and the contractor is familiar with the condition and difficulties that will affect the execution of the work. The contractor is responsible to indicate any discrepancies between the contractor drawings and actual field conditions. Submission of shop drawings will be construed as evidence that such examination has been made.

B. Guarantees and Warranties

1. Furnish all guarantees and warranties normally furnished with any purchased equipment.

Warranties shall be extended for an additional year to provide a two year warranty.

C. Finishes

1. Hangers, rods and other items except standard pipe and fittings shall be galvanized or a factory-applied shop coat. Items not factory or shop primed prior to installation shall be primed immediately after installation.

D. Cutting and Patching

1. Cutting & Patching shall be done under another section of these specifications. Core boring for all fire protection piping shall be done by this Contractor.

E. Materials

1. All materials and equipment to be new unless noted otherwise.
2. All products shall be UL Listed and/or FM Approved as required per NFPA 13 (e.g. sprinklers).

F. Substitution

1. No substitute material or manufacturer of equipment shall be permitted without a formal written submittal to the Engineer which includes all dimensional, performance and material specifications. The contractor takes full responsibility for the substitution and all changes resulting from the substitution. All items shall be submitted for review in conjunction with the submittal of the substitution. If the substitute is being utilized for financial reasons, the associated credit must be simultaneously submitted.
2. All substituted equipment shall conform to space requirements and performance requirements shown on contract documents. Contractor shall replace any equipment that does not meet these requirements at his own expense. Any modifications to associated systems or additional costs attributed to this substitution shall be at this contractor's expense.

G. Conflict

1. If a conflict occurs in the specifications and/or on the drawings, the more stringent situations shall apply.

1.5 PERMITS, CERTIFICATES, CODES AND ORDINANCES

A. The Fire Protection Contractor shall give all requisite notices and file all requisite plans relating to their work with the proper authorities. They shall also be responsible for coordination with applicable agencies and furnishing all materials and installation in accordance with their requirements. Applicable agencies shall include but not be limited to the local Building Dept., the local Fire Dept., State Dept. of Public Safety.

B. The Fire Protection Contractor shall apply and pay for all inspection permits, certifications of inspection, and license fees in connection with the fire protection work, and deliver to the Owner at the completion of work. All diagrams or drawings required by local and state authorities shall be supplied by this Contractor.

1.6 COORDINATION

A. Keep fully informed as to the size, shape and location of all openings required for their apparatus and give full information to the General Contractor and other subcontractors so that the openings may be built in advance.

B. All system and pipe routing are to be coordinated with building structure and other trades.

C. Obtain all information from the General Contractor and other contractors which may be necessary to facilitate the work and the completion of the project.

D. Refer to the fire protection drawings and all other drawings for a full comprehension of the extent and detail of the work to be performed.

E. This Contractor, before installing any of their work, shall see that it does not interfere with the clearance required for finished walls and ceilings, as shown on the Contract Architectural drawings and details.

F. Refer to the architectural reflected ceiling plans for ceiling types in any given area and locations of all lights, ceiling height changes, soffits and coffers. Coordinate the sprinkler layout with these plans.

G. Work installed by this Contractor which interferes with or modifies the Architectural designs as shown on the Contract Drawings shall be changed as directed and all costs incident to such changes shall be paid by the Contractor.

1.7 COORDINATION DRAWINGS

A. Before materials are purchased or work is begun, prepare coordination drawings showing the size and location of equipment, piping, etc., in the manner described under SUPPLEMENTARY CONDITIONS.

B. Fire Protection Contractor shall show on coordination drawings prepared by the General Contractor all of the fire protection work to be installed as part of this section of the specifications.

C. Coordination drawings are for the General Contractor's and the Architect's use during construction and shall not be construed as replacing any shop, "as-built" or record drawings required elsewhere in these contract documents.

1.8 SEISMIC BRACING

A. Provide seismic bracing designed in accordance with NFPA 13. Prior to beginning work, bracing equipment locations shall be coordinated and approved by a structural engineer provided by the contractor.

1.9 SITE EXAMINATION

A. Before beginning work, thoroughly examine the site and the Contract Documents.

B. No claim for extra compensation will be recognized if difficulties are encountered which an examination of site conditions and Contract Documents prior to executing contract would have revealed.

1.10 PROTECTION

A. Each Contractor shall be responsible for their work and equipment until finally inspected, tested and accepted. Carefully store materials and equipment which are not immediately installed after delivery to site. Close open ends of work with temporary covers or plug during construction to prevent entry of obstructing material.

B. Each Contractor shall protect work and material of other trades from damage that might be caused by their work or workmen and make good damage thus caused.

1.11 RECORD DRAWINGS

A. At the end of the project the Architect shall provide the Contractor with one set of the drawings in AutoCAD 2014 format. The Contractor shall modify these drawings or produce new drawings that accurately represent the actual installation of the system. The Contractor shall deliver to the Architect one set of reproducible "as built" drawings, and a compact disc or DVD with the drawings in AutoCAD 2014 format for the Owner's permanent record.

B. The "as built" drawings shall show the actual location of all valves, sprinkler heads, flow switches, etc.

C. A copy of all hydraulic calculations shall be included with the record drawings.

1.12 PROJECT CLOSEOUT

A. A certificate of completion shall be issued by the contractor indicating that the installation is in conformance with the construction documents and all applicable local, state and federal statutes and codes. All submittals, as-builts, and O&M manuals are to be provided for the engineers review prior to request for completion certificates. All punch list items must be completed to the satisfaction of the engineer. The contractor must verify that all sequences of operations and controls have been incorporated and all systems and equipment are working per the specified sequences of operations. Premature requests for final inspections that require re-inspection of deficient items will result in back charges of the costs associated with the re-inspection.

PART 2 PRODUCTS

2.1 PIPE AND FITTING

A. Wet System

1. Standard weight black steel pipe, schedule 40, ANSI UL 852 or FM 1630, grade b, with cast iron, 175-pound, screwed fittings for piping 2 inch and smaller.
2. Standard weight black steel pipe, schedule 10, ANSI UL 852 or FM 1630, with mechanical joints using either rolled or cut grooved method.
3. CPVC shall be used where applicable, provided the piping and fittings are installed according to their listing and NFPA 13, and is acceptable by the AHJ.
4. All FDC piping between FDC outlet and check valve with ball drip shall be ASTM A53 or ASTM A795 hot dipped galvanized steel schedule 40 pipe with grooved connections.

B. Underground service shall be ductile iron conforming to AWWA C151 with fittings conforming to AWWA C153 and installed per the requirements as outlined in NFPA 13.

C. Piping larger than 2 inch shall be assembled with mechanical joints using a rolled grooved method. Threaded connections are not acceptable on schedule 10 piping.

D. Flexible couplings shall be provided for all piping 2 ½” or greater as required by NFPA 13.

2.2 VALVES

A. Valves shall be Victaulic, Jenkins Bros., Fairbanks, Walworth, Crane, or equal as follows - Description following with the respective catalog number is intended to serve as a guide to design, quality and characteristics desired.

B. Fire department valves located in stairways shall be cast brass, angle type, 2-1/2", with cap and chain and 2-1/2" x 1-1/2" reducer. Potter Roemer 4060.

C. Gate Valves - iron body, 175 lb. bronze trim, outside screw and yoke, solid wedge, rising spindle, screwed or flanged ends, Jenkins Fig. #824-A or Fig. #825, UL & F.M. Approved.

D. Check Valves - bronze, 175 lb. swing check with tapped body, renewable bronze seat ring, bolted cover, flanged ends, Jenkins Fig. #843, UL & F.M. Approved.

E. Drain Valves - bronze 175 lb. inside screw, solid wedge, non-rising spindle, Jenkins Fig. #707 with Fig. #658 cap and chain.

F. Floor control assemblies shall consist of the following components: butterfly valve w/ supervisory switch, riser manifold (with pressure relief valve where required), and check valve (where required).

2.3 DOUBLE CHECK VALVE ASSEMBLY

A. Furnish and install Apollo DCLF 4A double check valve assembly on incoming fire service piping as shown on the Drawings. Unit shall be installed complete with valves on both inlet and outlet and provided with one rebuilding kit if applicable. Entire unit shall be UL listed, and approved by Factory Mutual and the local water authority. Unit may be epoxy coated cast iron or stainless steel construction, provide tamper switches on the OS&Y valves and a master flow switch for the fire service.

2.4 FLOW / PRESSURE SWITCHES

A. Flow / Pressure switches shall be furnished and installed by this Contractor. Wiring from flow switches to main panels by Electrical Contractor.

B. Flow switches shall be adjusted to retard feature to 30 seconds.

C. Flow / Pressure switches shall be FM and UL listed by Potter, Reliable, Grinnell, Tyco, Victaulic or equal. FM & UL Listed.

2.5 SUPERVISORY SWITCHES

A. Supervisory switches shall be furnished and installed by this Contractor. Wiring from supervisory switches to man panels by electrical contractor.

B. Switch locations shall be coordinated with the Electrical Contractor.

C. Supervisory switches shall be Potter, Reliable, Grinnell, Tyco, Victaulic or equal. FM & UL Listed.

2.6 FIRE DEPARTMENT CONNECTION

A. The system shall be provided with one fire department connection, Siamese type or Storz type, as required by the local fire department.

B. Siamese type fire department connection shall be two-way flush type polished chrome-plated brass complete with plugs and chains, as manufactured by Potter-Roemer, W.D. Allen or Globe, similar to Potter-Roemer #5025 back outlet, size 2 1/2" x 2 1/2" x 4.

C. Storz type fire department connection shall be hard coated aluminum with Storz on one end and female national pipe thread on the other complete with blind caps and chains similar to Potter-Roemer 5799-01.

D. Provide signage on exterior of building indicating FDC. Provide an approved sign on the building face. Sign shall letters not less than 6 inches in height stating "FDC". Signs are subject to approval by the AHJ. Signage shall meet the requirements of NFPA 13 and 780 CMR.

2.7 AUTOMATIC BALL DRIP

A. Ball Drip - Potter-Roemer, W.D. Allen or Globe, similar to Potter-Roemer Model 5981 automatic ball drip, 3/4 inch size, brass body.

2.8 INSPECTORS TEST AND DRAIN CONNECTIONS

A. Wet system test pipe shall not be less than 1" in diameter and shall be provided for each system. Each test connection shall include a test valve with smooth-bore corrosion resistant orifice, auxiliary drain valve, and site glass which shall be readily accessible and labeled. Test valve shall provide flow equivalent to one sprinkler. The discharge shall be to the outside to an area that can accept full flow without water damage.

B. Dry system test pipe shall not be less than 1-1/2" in diameter terminating in a smooth bore corrosion resistant orifice giving a flow equivalent to the smallest sprinkler shall be provided for each system. Each test connection shall be readily accessible, labeled, and located near the remote branch line of each system. The discharge shall be to the outside to an area that can accept full flow without water damage.

C. Auxiliary drain connections shall be provided when a change in piping direction prevents drainage of sections of branch lines or mains through the main drain valve. The drain shall consist of a valve not smaller the 3/4" size and plug.

2.9 SPRINKLER HEADS

A. Sprinkler heads shall be of the type and have the finishes indicated on the drawings. All sprinkler heads located in suspended ceilings shall be and installed in center of ceiling tile unless noted otherwise.

B. All sprinkler heads shall be quick response.

C. All pendent sprinkler heads through ceiling shall be installed with escutcheon plates matching the finish of the sprinkler head.

D. Submitted and approved sprinkler heads shall be included in FP contractors' hydraulic calculations.

E. Sprinkler connections have been designed utilizing hard pipe connections unless noted otherwise.

F. FP contractor shall be permitted to use flexhead connections provided all locations are shown on shop drawings and accounted for in hydraulic design of system. Flexhead connections shall be by ASC Engineer Solutions or approved equal. All flexhead connections shall be installed per the manufacturer's installation instructions.

2.10 SPARE SPRINKLERS AND CABINET

A. Sprinkler cabinets shall be furnished containing spare sprinklers and special sprinkler head wrench and be installed where directed by the Architect. Cabinets shall be heavy gauge steel with lock, painted with rust inhibitive paint and be standard equipment of the sprinkler manufacturer. Number of spare sprinklers and cabinets shall be in conformance with NFPA 13.

2.11 HANGERS, MISCELLANEOUS SUPPORTS AND INSERTS

A. Pipe hangers and supports shall be installed on all piping systems as required per NFPA 13.

B.

PIPE SIZE	MINIMUM ROD DIAMETER
1" to 4"	3/8 inch
5",6" and 8"	1/2 inch
10" and 12"	5/8 inch

C. Hangers and supports shall be furnished complete with all appurtenances and shall be Tolco, Erico, Grinnell, Carpenter- Paterson, or equal. Hangers and supports shall be hot-dipped galvanized where exposed and dip painted where concealed. All hangers and supports shall bear the approval of a recognized testing agency.

2.12 SLEEVES

A. Sleeves for piping passing through foundation walls shall be steel pipe, standard weight, two sizes larger than pipe.

B. Sleeves for piping passing through interior wall shall be steel pipe, standard weight or 20 gauge galvanized sheet metal and shall be set flush with walls.

C. Sleeves for piping passing through concrete floors shall be black steel pipe and shall extend one inch above floor and be flush below. Within chases 26 gauge galvanized sheet metal may be used.

D. All piping passing through foundation walls shall be provided with expandable wall hole closure. Closure shall be Link-Seal as manufactured by Thunder line Corp.

E. All sleeve openings around piping other than mentioned in sub-paragraph "D" shall be sealed with fire-retardant silicone foam as manufactured by Chase Technology Corp.

F. A minimum annular space of 1" shall be maintained between pipe and sleeve.

2.13 SPRINKLER ZONE STATIONS

A. Furnish and install Grinnell, Tyco, Victaulic, or equal, wet and dry type sprinkler alarm check valve stations complete with drain, gauges, OS&Y, valves, retard chamber, and all other accessories, including air maintenance compressor and quick opening device on the dry system, as required by the local fire department and/or Insurance underwriter. Entire unit shall be FM and UL Approved. Alarm check valve stations shall be type (wet or dry) as indicated on plans.

2.14 FIRE DEPARTMENT VALVE CABINETS

A. Fire department valve cabinets shall be Potter-Roemer series 1800 FRC or equal.

2.15 ALARM BELL

A. Furnish and install Potter model PBA-AC alarm bell. Size and location shall meet the requirements of the local authority having jurisdiction. Wiring to alarm bell by electrical contractor.

2.16 SIGNAGE

A. Fire protection signage shall be installed per NFPA 13. Signs shall be permanently marked, weatherproof, and metal or rigid plastic. Signs shall be secured with corrosion-resistant wire or chain. The following signs shall be included:

1. General Information Sign
2. Hydraulic Design Information Sign (for each system)
3. Additional Signage for Dry Pipe Systems such as sign indicated the number and location of all low point and auxiliary drains
4. Identification Signage at all – Control Valves, Drain Valves, Test Connections
5. Fire Department Connection – See Fire Department Connection section of this specification.

PART 3 EXECUTION

3.1 DESIGN CRITERIA

A. The design criteria shall be as specified on the fire protection drawings.

3.2 INSTALLATION AND WORKMANSHIP

A. Refer to architectural, structural, electrical, plumbing and mechanical drawings for the location of all drains, ventilation ducts, electrical equipment, etc., in relation to all ceilings and other work. All piping shall be installed to conform to the ceiling treatment as shown on the architectural drawings and shall be clear of all equipment as required by architectural treatment. Where ceilings are installed, all sprinkler piping shall be concealed above ceiling and pendent heads provided.

B. Reference to the architectural general and detail plans and structural plans shall be made which clearly indicate the type of building construction in which the sprinkler work shall be installed.

C. The entire work provided in this Contract shall be constructed and finished in every respect in a workmanlike and substantial manner. This Contractor shall furnish and install all such parts as may be necessary to complete the systems in accordance with the best trade practice and to the satisfaction of the Architect.

D. Keep other Contractors fully informed as to the shape, size and position of all openings required for apparatus and give full information to the General Contractor and other Contractors sufficiently in advance of the work so that all openings may be built in advance. Furnish and install all sleeves, supports, etc., as required.

E. In the case of failure to give proper and timely information as noted above, provide cutting and patching or have the same done by the General Contractor and other Contractors which may be necessary to facilitate work and the completion of the whole project.

F. Installation shall conform to the requirements of the National Fire Protection Association, local codes, other agencies having jurisdiction, and the recommendations of the Owner's insurance company's rating agency.

G. Work to be performed shall include a complete sprinkler system to provide 100% coverage to every area of the building.

H. All optional devices and wiring shall be included to obtain the most favorable rating from the Owner's insurance company's rating association.

3.3 DRAWINGS

A. Prepare and obtain approval of complete working drawings and hydraulic calculations of the entire fire protection system. Contractor shall have drawings and hydraulic calculations stamped by a registered fire protection engineer.

B. Before buying or installing any equipment, complete working plans and calculations shall be submitted by the Fire Protection Contractor for approval by the Insuring Agency, his rating association, and the local fire department. The word "approved" as used in these specifications means acceptable to the Insuring Agency and the local fire department.

C. After approval of working plans is received from the above authorities, seven (7) copies shall be submitted to the Architect for approval.

3.4 TEST

A. After completion, the system shall be subject to a hydrostatic pressure of not less than 200 psi for a period of two hours in the presence of the AHJ, Architect and local Fire Department Official. Any defects presented during the test period shall be repaired by the Fire Protection Contractor at their expense. Defects shall be repaired by replacing the defective parts with new material.

B. After completion of above test and approval of the Architect, the Fire Protection Contractor shall furnish the Architect with a certificate, as required by the National Fire Protection Association.

C. The authority having jurisdiction shall be notified as to the time and place of the field acceptance test.

3.5 GUARANTEE

A. Attention is directed to provisions of the GENERAL CONDITIONS regarding guarantees and warranties for work under this Contract.

1. Manufacturers shall provide their standard guarantees for work under this section. However, such guarantees shall be in addition to, and not in lieu of, all other liabilities which the

manufacturer and Contractor may have by law or by other provisions of the Contract Documents.

2. All materials, items of equipment and workmanship furnished under this section shall carry the standard warranty against all defects in material and workmanship. Any fault due to design which may develop shall be made good, forthwith, by, and at the expense of, this Subcontractor, including all other damage done to areas, materials and other systems resulting from this failure.
3. Guarantee that all elements of the system are of sufficient capacity to meet the specified performance of requirements as set forth herein or as indicated.

3.6 CLEANING OF SYSTEMS

A. The Fire Protection Contractor shall be responsible for the cleaning and purging the fire protection systems after installation and before system operation. Any damage to parts of the buildings, its finish or furnishings, due to this Contractor's failure to properly clean the system, shall be repaired or replaced, at his expense.

B. All sprinkler heads and equipment shall be thoroughly cleaned of all plaster, sticks rust stains and other foreign matter or discoloration, leaving every part in an acceptable condition and ready for use. Surfaces shall be cleaned, polished and left bright.

C. All finished metal work shall be cleaned, polished and left bright. All equipment, pipe, valves, drains and fittings shall be cleaned of grease, metal cutting and sludge, which may have accumulated during construction and/or testing.

3.7 PAINTING OF MATERIALS AND EQUIPMENT

A. Unless specified otherwise factory-built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.

B. Where exposed, fire protection piping shall be painted to match the ceiling.

3.8 FIRESTOPPING

A. The Contractor shall provide UL listed through penetration fire stopping systems for all penetrations of fire rated floor/ceiling, roof/ceiling and wall assemblies. Coordinate the required UL system with the architectural plans and the material of the piping.

B. Submit each UL listed through penetration fire stopping system to the Architect for review.

3.9 INSPECTION AND TESTS

A. All inspections, examinations and tests required by the authorities and/or agencies specified in this Section of the specifications shall be arranged and paid for by this Subcontractor, as necessary to obtain complete and final acceptance of the Fire Protection Work. They shall deliver certificates of all such inspections to the Architect.

3.10 INSPECTION SERVICE

A. After completion of the Fire Protection installation and at the start of the guarantee period, Contractor shall execute the National Automatic Sprinkler and Fire Control Association, Inc., Standard Form of "Inspection Agreement", without charge to the Owner, calling for four (4)

inspections of the system during the guarantee year. During the guarantee yeas, inspections shall be made as per the Inspection Agreement plus all maintenance as required by NFPA 25 shall performed during the course of the fourth inspection:

1. Lubrication of operating stems of all interior control valves
2. Operation of water motor gong and/or electric alarms
3. Cleaning of alarm valves

B. The Standard Form of the National Automatic Sprinkler and Fire Control Association, Inc., "Report of Inspection," shall be filled out in triplicate after each inspection and the copies sent to the Owner, Insurance Carrier, Fire Department or other authorities that the Owner may designate.

END OF SECTION 210000

SECTION 220000
PLUMBING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Examine all other Sections of the Specifications for requirements, which affect work under this Section whether or not such work is specifically mentioned in this Section.

C. The Plumbing Drawings shall not limit the Subcontractors responsibility to determine the full extent of his work as required by all Contract Drawings.

1.2 SCOPE OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this section and, without limiting the generality thereof, including:
   1. Complete interior storm and sanitary drainage system, including soil, waste, and vent piping within the building to ten (10’-0”) outside the inside surface of the exterior foundation wall of the building.
   2. Complete interior water systems, including cold, hot, and re-circulated hot water piping. Cold water to commence from new service entrance location.
   3. Complete hot water generation systems.
   4. Drainage specialties such as drains, cleanouts, vacuum breakers, shock absorbers, wall hydrants, hose bibs, etc.
   5. Backflow prevention devices on all equipment requiring same.
   6. Plumbing fixtures and all trim.
   7. All drilling of holes for piping, including but not limited to steel, concrete, and wood coring. Patching to be performed by others.

B. Items to be Furnished Only: Furnish access panels to the General Contractor for distribution by him to the various trade sections in whose work the panels occur.

C. Related work in Other Sections:
   1. Cutting and patching.
   2. Excavation, trenching and backfill.
   3. All electric power wiring, except as specified herein.
   4. Building heating, ventilating and air conditioning.
   5. Flashing of floor drains and vents through the roof.
   6. Toilet room accessories.
   7. Installation of access panels.
   8. Painting.
   9. Sprinkler system.

D. The Plumbing Contractor shall coordinate their scope of work with requirements as noted on architectural drawings.

1.3 CODES, ORDINANCES AND PERMITS

A. All work shall be installed in accordance with the laws, ordinances, rules and regulations of all local and state authorities having jurisdiction, and the rules and regulations of the State Plumbing and Gas Codes. In case of conflict, the higher standard shall prevail. Extra payment will not be allowed for work or changes required by code enforcement authorities.

B. Apply and pay for inspection permits, certificates of inspection, and license fees in connection with this work, and deliver to the Owner at the completion of the work. All diagrams or drawings required by local or state authorities shall be supplied by This Contractor.

C. All equipment, fixtures, and valves shall be compliant with Lead Reduction NSF 61 2014 standard.

1.4 JURISDICTIONAL DISPUTES

A. Subcontract all portions of this work as necessary to avoid jurisdictional disputes and work stoppages that could arise during the installation of this work.

1.5 INTENT

A. It is the intention of these specifications and drawings to require the equipment to be furnished complete in every respect, and this Contractor shall furnish all equipment needed and usually supplied in connection with such systems. Equipment, materials and articles incorporated in the work shall be new, and of the best grade of their respective kinds for the type of work involved.

1.6 DRAWINGS

A. The drawings show the extent and general arrangement of piping, and locations of the equipment. Piping, fixtures, and equipment are shown diagrammatically. This Contractor shall be responsible for the locations in the most practical manner, free from interference with other piping or structural features. If any changes from the drawings are deemed advisable, details of such proposed changes shall be submitted for approval. No changes shall be made without such approval. Maintain maximum headroom or space conditions at all points. Where headroom or space conditions appear inadequate, Architect shall be notified before proceeding with the installation.

1.7 SHOP DRAWINGS AND SUBMITTALS

A. Within thirty days after award of the contract, provide six copies of schedule of materials proposed to be submitted for approval, prior to submission of any detailed drawings. The Architect will review this schedule and may supplement it with additional items or eliminate some items.

B. Supply manufacturers' drawings of all materials, equipment and apparatus remaining on the list, giving full information as to dimensions, construction, capacity and other pertinent facts, which shall be submitted to the Architect, and approval secured, before apparatus is ordered, built or installed. Samples shall be submitted, if required.

C. Approval by the Architect of shop drawings for any materials, apparatus, devices and layouts shall not relieve the responsibility of furnishing same of proper dimensions, size, quantity, quality and all performance characteristics to efficiently perform the requirements and intent of the contract documents. Such approval shall not relieve This Contractor from responsibility of errors of any sort on the shop drawings. If the shop drawings deviate from the contract documents, advise the Architect of the deviations in writing accompanying the shop drawings, including the reasons for the deviations. Shop drawings without specific notations or without schedules as described herein, may be returned not approved. Each shop drawing for any item shall be clearly identified with codings used on the drawings complete with name and/or locations of equipment. Shop drawings covering more than one item shall be accompanied by a suitable location schedule.

D. Shop drawings are required for:
   1. Plumbing fixtures and equipment.
   2. Pipe and fittings.
   3. Valves.
   4. Pipe insulation.
   5. Drains and appurtenances.
   6. Pipe hangers, supports and special equipment.
   7. Water heaters and associated equipment.

1.8 SUBSTITUTIONS

A. Substitutions of equipment or materials other than those shown on the drawings or named in the specifications may be made only with the written approval of the Engineer, who reserves the right to require adequate proof of the quality of the substitute before permitting its use.

B. Where this Contractor proposes to use an item of equipment other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundations, piping, wiring, or of any other part of the mechanical, electrical or architectural layout, all such redesign, and all new drawings and detailing required therefore shall, with the approval of the Architect, be prepared by This Contractor at his expense.

C. Where such approved deviation requires a different quantity and arrangement of ductwork, piping, wiring, conduit and equipment from that specified or indicated on the drawings, with the approval of the Architect, This Contractor shall furnish and install any such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

1.9 COORDINATION

A. The work shall be so performed that the progress of the entire building construction, including all other trades, shall not be delayed or interfered with. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as required.

B. Any core or hole drilling required for the installation of the plumbing systems shall be brought to the structural engineer and architect’s attention prior to performance of this work.

C. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other sections. Any conflicts shall be referred immediately to the Owner’s Representative for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Owner’s Representative’s satisfaction at no expense to the Owner.

D. Refer to Architectural Drawings prior to installation of visible material and equipment, including access panels. Where items are not indicated, request the information from the Architect.

E. If any plumbing work has been installed before coordination with other trades so as to cause interference with the work of such trades, all necessary adjustments and corrections shall be made by the plumbing trades involved without extra cost to the Owner.

1.10 COORDINATION DRAWINGS

A. Before materials are purchased or work is begun, prepare coordination drawings showing the size and location of equipment, piping, etc., in the manner described under SUPPLEMENTARY CONDITIONS.

B. Plumbing Contractor shall show on coordination drawings prepared by the General Contractor all of the plumbing work to be installed as part of this section of the specifications.

C. Coordination drawings are for the General Contractor's and the Architect's use during construction and shall not be construed as replacing any shop, "as-built" or record drawings required elsewhere in these contract documents.

1.11 RECORD DRAWINGS

A. The Architect will furnish the Plumbing Sub-Contractor AutoCAD 2014 files of the plumbing drawings as issued for this contract. The Contractor shall change these drawings to indicate accurately and neatly the actual pipe routing and pipe sizes, as well as the actual locations of all equipment. At the end of the project the Contractor shall deliver to the Architect one set of reproducible "as built" drawings and a compact disc or DVD with electronic files of the drawings in AutoCAD 2014 format for the owner's permanent record.

B. The "as built" drawings shall show the actual location and valve tag number of all valves.

C. The Architect will not certify the accuracy of the Record Drawings. This is the sole responsibility of the Plumbing Sub-Contractor.

D. Record Drawings shall show record condition of details, sections, riser diagrams and corrections to schedules. Schedules shall show actual manufacturer, make and model numbers of final equipment selection.

1.12 WORKMANSHIP

A. The entire work provided in this division shall be constructed and finished in a workmanlike and substantial manner. It is not intended that the drawings show every pipe, fitting and appliance, but This Contractor shall furnish and install all such parts as may be necessary to complete the systems in accordance with the best practice and to the satisfaction of the Architect.

B. Keep other contractors fully informed as to the shape, size and position of all openings required for apparatus and give full information to the General Contractor and other subcontractors sufficiently in advance of the work so that all openings may be built in advance. Furnish and install all sleeves, supports, etc., specified herein, or required.

C. In case of failure to give proper and timely information, provide cutting and patching or have same done by the General Contractor, but in any case, without extra expense to the Owner.

D. Obtain detailed information from the manufacturers of apparatus as to the proper method of installing and connecting same. Obtain all information from the General Contractor and other subcontractors which may be necessary to facilitate the work and the completion of the whole project.

1.13 ACCESSIBILITY

A. All work shall be installed so that all parts required are readily accessible for inspection, operation, maintenance and repair. Minor deviations from the drawings may be made to accomplish this end, but changes of magnitude shall not be made without prior written approval from the Architect.

1.14 PROTECTION

A. Be responsible for work and equipment until finally inspected, tested and accepted. Carefully store materials and equipment which are not immediately installed after delivery to the site. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.

B. Protect work and material of other trades from damage that might be caused by work or workmen and make good any damage thus caused.

1.15 EXAMINATION OF SITE

A. Before submitting proposal, visit the site, examine its condition, and become acquainted with the obstacles and advantages for performing the work. Study the drawings and

specifications explanatory of the work to be performed and compare them with the information gathered by the examination of the site.

B. No claim for extra compensation will be recognized if difficulties are encountered which an examination of the site conditions and contract documents prior to executing the contract would have revealed.

1.16 TEMPORARY OPENINGS

A. Ascertain from examination of the architectural drawings, whether any special temporary openings in the building will be required for the admission of apparatus furnished under this contract, and notify the Architect accordingly. In the event of failure to give sufficient notice to the Architect in time to arrange for these openings during construction, assume all costs of providing such openings thereafter.

1.17 TESTS

A. Furnish all labor, material, instruments, supplies and services, and bear all costs for the accomplishment of the tests specified herein. Correct all defects appearing under test, and repeat the tests until no defects are disclosed. Leave the equipment clean and ready for use.

B. Perform all tests, other than specified herein, which may be required by legal authorities or by agencies to whose requirements this work is to conform.

1.18 GUARANTEE

A. Attention is directed to the provisions of the GENERAL CONDITIONS and SUPPLEMENTARY CONDITIONS regarding guarantees and warranties for work under this contract.

B. Manufacturers shall provide their standard guarantees for work under this section. However, such guarantees shall be in addition to, and not in lieu of, all other liabilities which the manufacturer and contractor may have by law or by other provisions of the Contract Documents.

C. All materials, items of equipment and workmanship furnished under this section shall carry the standard warranty against all defects in material and workmanship. Any fault due to design which may develop shall be made good by and at the expense of This Contractor, including all other damage done to areas, materials and other systems resulting from this failure.

D. This Contractor shall guarantee that all elements of the systems are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced.

F. Any apparatus that requires excessive service during the guarantee period will be considered defective and shall be replaced.

G. Furnish, before the final payment is made, a written guarantee covering the above requirements.

1.19 COMMISSIONING OF PLUMBING EQUIPMENT AND SYSTEMS

A. RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, including Section 018100 – General Commissioning Requirements, apply to this Section.

B. SUMMARY

1. Section includes commissioning process requirements for water heaters.
2. During Functional Testing, it is anticipated that the equipment will function as intended. Failure of an item includes excessive noise, failure to perform the intended function, or a deviation of more than 10 percent from the intended performance.
3. First-round testing is included in the CxA's budget. Any testing necessitated by above-described failures shall be at extra cost, and may be borne by the contractor.

C. DEFINITIONS

1. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
2. CxA: Commissioning Authority.
3. EOR: Engineer of Record
4. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

D. CONTRACTOR'S RESPONSIBILITIES

1. Allow sufficient time in the construction schedule, presented as a task in all project schedules, for on-site Functional Testing of equipment that is within the scope of work. CxA shall be consulted as early as possible to determine the appropriate amount of time necessary for testing. This time shall commence after all work is complete and equipment start-up sheets have been submitted and approved by the EOR. It will end prior to occupancy of the space. The time allotted for Commissioning SHALL NOT coincide with building flushing, balancing, or other testing or operations without the specific approval of the CxA.
2. Allow sufficient time in the schedule for repair of any faulty systems or components revealed during Functional Testing. One week is recommended.
3. Allow 5 working days minimum, prior to occupancy of the building, and after any repairs or reprogramming as per the previous item, for follow-up Functional Testing to prove that equipment and systems are operating and reporting properly
4. Perform all equipment inspections and testing prior to commissioning. Submit a complete manufacturer-recommended start-up checklist for all major equipment at least 2 weeks prior to commissioning.
5. Participate in plumbing system, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
6. Provide information requested by the CxA for final commissioning documentation.
7. Provide a technician that is thoroughly familiar with the programming and operation of the system controls for assistance during functional testing.
8. Provide personnel as necessary to assist in the Functional Testing of the plumbing equipment.
9. Repair, reprogram, or otherwise correct any deficiencies that are revealed during functional testing, and report the corrections in the forma agreed to with the CxA and Project Management.
10. Assist as necessary in any retesting that is necessitated by failure of equipment or systems to perform as per the design intent.
11. Provide material for inclusion in the commissioning report. For example, as-built drawings, start-up reports, and submittals for major equipment.

E. CxA'S RESPONSIBILITIES

1. Include CxA responsibilities in this article that have an impact on Contractor's activities and responsibilities.
2. Provide Project-specific commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
3. Approved start-up reports, balancing reports, and control system point-to-point checklists and calibration reports shall serve as pre-functional testing. The CxA may

choose to participate in this work.
4. Direct commissioning testing.
5. Verify testing, adjusting, and balancing of Work are complete.
6. The CxA shall judge whether equipment or systems function in a manner consistent with the design intent. A report shall be produced that lists any discrepancies.
7. Testing of any systems or equipment that fails the initial functional test will be repeated until all systems perform in accordance with the design intent and the intended operating sequences. Retesting may be additional to the contract value, and the cost may be passed through to the contractor responsible for the non-performing system.
8. A final commissioning report will be generated after all functional testing is complete. This report will contain as-built drawings, all testing, balancing, and start-up reports, water treatment reports, submittals for major equipment, and control system submittals.

F. COMMISSIONING DOCUMENTATION
1. Provide the following information to the CxA for inclusion in the commissioning plan:
   a. Plan for delivery and review of submittals, system manuals, and other documents and reports.
   b. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
   c. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for plumbing systems, assemblies, equipment, and components to be verified and tested.
   d. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
   e. Certificate of readiness certifying that plumbing systems, subsystems, equipment, and associated controls are ready for testing.
   f. Test and inspection reports and certificates.
   g. As-built drawings
   h. Corrective action documents.
   i. Verification of testing reports.
   j. Maintenance requirements or recommendations for all equipment provided by the Contractor.
   k. Recommended spare parts list
   l. Contact names and phone number for warranty or maintenance during the warranty period, as well as a 24-hour emergency contact.

G. SUBMITTALS
1. Paragraphs below are "Informational Submittals." See Division 01 Section "Submittal Procedures" for definition of "Informational Submittals."
2. Certificates of completion of installation, prestart, and startup activities.
3. Start-up/checkout checklists and reports
4. As-built drawings

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Sanitary waste, storm, and vent piping systems above grade, within the building foundation walls:
1. Drainage piping 2" and larger shall be no hub cast iron with rubber gaskets and mechanical couplings. Vent piping 2” and larger may be DWV type copper with wrought copper drainage fittings, 95/5 lead free solder joints.
2. Drainage piping 1 1/2" and smaller shall be DWV type copper with wrought copper drainage fittings, 95/5 lead free solder joints.

B. Storm, Sanitary waste and vent drainage piping below grade:

1. Storm drainage, sanitary waste, and sanitary vent piping: cast iron, bell and spigot, rubber gasket joints, service weight, coated on exterior.

C. Water piping:

1. Underground domestic water: Type K copper tubing conforming to ASTM B88 with cast brass fittings conforming to ANSI B16.22.
2. Above ground: Copper tubing, Type L, conforming to ASTM B 88 with solder joint wrought copper fittings conforming to ANSI B16.18 or B16.22, lead free solder joints.

2.2 VALVES

A. Each valve type shall be of same manufacturer and appropriate for service in which used; valves shall be Milwaukee, Watts, Apollo, or approved equal. Type proposed for each service shall be submitted for approval. In general, shut- off valves, except for exposed stops at fixtures, shall be ball valves.

B. Each system shall be provided with valves as required by Code and as specified. Valves shall be installed for isolation and to facilitate operation, replacement and repair. Provide access panels where valves are concealed behind non- removable ceilings or walls. Provide shut off valves for gas and water supply piping to individual fixtures and appliances.

C. Valves shall be:

1. Ball valves - 2 inches and smaller, bronze, 400 lb., 1/4 turn solder ends for copper tubing.
2. Ball valves - 3 inches and larger - 400 lb., 1/4 turn, bronze. IPS thread ends.
3. Check valves - 2 inches and smaller - brass, 125 lb., spring check, IPS thread ends, Nibco or equal.
4. Check valves - 2-1/2 inches and larger - bronze, 125 lb., spring check, flanged ends, Nibco or equal.
5. Drain valves - cast bronze, 1/2" and 3/4", threaded outlet for garden type hose connection, Nibco #72.

2.3 BACKFLOW PREVENTERS

A. Backflow preventer: Backflow preventers shall be installed to prevent backflow of contaminated water in the potable water supply:

1. On all hose end faucets such as hose bibs, wall hydrants, service sink faucets, etc. - Watts #8A, non-removable type or equal.
2. On any and all equipment: Watts #009, reduced pressure type, unless otherwise noted.

2.4 MISCELLANEOUS PIPING MATERIALS

A. Nipples: Nipples shall conform to WW-N-351 and shall be the same material as the piping in which installed.

B. Unions: Unions shall be brass or bronze, 125 lb., either threaded or with solder joint ends, conforming to WW-U-516 for use in copper tubing. For use in steel piping unions shall conform to WW-U-531.

C. Insulating bushings and Unions: hard rubber threaded bushing inserted between two dissimilar metals.

D. Flanges on copper tube or pipe: cast bronze, 150 lb., solder joint connection.

E. Flanges on steel piping: carbon steel, 150 lb., welding neck or slip-on ASTM A181, Grade 1, ANSI B16.5

F. Floor and ceiling escutcheon plates: Floor and ceiling escutcheon plates shall be split hinged, locked type. Plates shall be of pressed steel with a heavy coating of copper, nickel and chromium.

G. Copper: Copper for flashing shall be soft temper or light cold rolled, minimum weight 16 ounces per square foot.

H. Sheet lead: Sheet lead for flashing shall be at least four pounds per square foot.

I. End cleanout: Threaded brass tapered plug fitted with raised head for cast iron piping with plug fitted with raised head.

J. Wall cleanouts: Chrome plated steel access panels, complete with frame and anchor straps, concealed hinges, slotted actuated cylinder lock installed flush with wall to gain access to valves and cleanouts. Access panels shall have general characteristics of Zurn, Josam, Smith #4761 or #4766 or equal.

K. Floor cleanouts: Cast iron, raised head caulking plug, brass cleanout cover flush mounted with flanged ring having anchor lugs, nickel-bronze scoriated hinged cover plate with "CO" cast in the cover, vandal-proof screws, similar to Zurn, Josam, Smith #4021, or equal. Access covers in all finished areas shall be similar to Zurn, Smith #4160 or 4200 or equal, with identical inlay of adjacent materials and vandal-proof screws.

L. Shock or water hammer arrestors: Shock or water hammer arrestors shall conform to the requirements of PDI-WH-201, ASSE 1010, or ANSI A112.26.1, size as required. Units shall be the standard factory prefabricated products as manufactured by Jay R. Smith, Amtrol, or equal. Provide at the last fixture on all pipe runs exceeding twenty feet in length and at all fixtures with automatic solenoid or cylinder operated valves, automatic flush valves, quick-closing valves or solenoid valves and where indicated on the drawings. Fixtures and equipment in battery installation may use a single water hammer arrester properly sized for the connected load.

2.5 HANGERS, SUPPORTS AND INSERTS

A. Pipe - 2 inches and smaller - 1A band type complete with threaded rod hanger nut, lock nut and sized to encompass insulation and pipe supported, similar to Carpenter-Patterson Fig. 1A or 122 CT or equal.

B. Piping - 2-1/2 inches and larger - clevis hanger type complete with threaded rod, locking and adjusting nuts and sized to encompass insulation and pipe supported, similar to Carpenter-Patterson Fig. 100 or equal.

C. Where due to space requirements, pipe must run close to structure above, a roll hanger with two threaded rods and nuts shall be used similar to Carpenter-Patterson Fig. 142 or Fig. 109.

D. Supports for piping from below shall be Carpenter-Patterson Fig. 333 or equal.

E. Insulation protective saddles shall be provided at all hanger locations for insulated piping.

F. Extension pipe or friction deck clamp shall be used on all piping except water piping passing through floors, similar to Carpenter-Patterson Fig. 126.

G. Pipe hangers and supports shall be installed for all piping systems as follows:

PIPE SIZE	MINIMUM ROD DIAMETER
to 1 inch	3/8 inch
to 2 inch	3/8 inch
to 3 inch	1/2 inch
to 6 inch & larger	5/8 inch

H. Hangers and supports shall be acoustically protected by means of resilient type clamps and isolation. They shall be furnished complete with all appurtenances and shall be Hold-Rite, Grinnell, Carpenter-Patterson, or equal. Hangers and supports shall be hot-dipped galvanized where exposed and dip painted, where concealed. Copper tubing shall be suspended from copper plated hangers.

2.6 SLEEVES

A. Sleeves for piping passing through foundation walls shall be steel pipe, standard weight, two sizes larger than pipe.

B. Sleeves for piping passing through interior wall shall be twenty-gauge galvanized sheet metal and shall be set flush with walls.

C. Sleeves for piping passing through concrete floors shall be black steel pipe and shall extend one inch above floor and be flush below. Within chases 26-gauge galvanized sheet metal may be used.

D. All plumbing piping passing through foundation walls shall be provided with expandable wall hole closure. Closure shall be Link-Seal as manufactured by Thunderline Corp.

E. All sleeve openings around piping other than those provided with Link-seals shall be sealed with fire-retardant silicone foam as manufactured by Chase Technology Corp.

2.7 DRIP PANS

A. Examine the drawings and in cooperation with the Electrical Contractor confirm the final location of all electrical equipment to be installed in the vicinity of piping. Plan and arrange all overhead piping no closer than two feet from a vertical line to electric motors and controllers, switchboards, or similar equipment. Piping is not permitted in electric equipment, transformer, switch gear and telephone gear rooms.

B. Where the installation of piping does not comply with the requirements of foregoing paragraph, where feasible the piping shall be relocated.

C. Where relocation of piping is not feasible, furnish gutters as follows:
   1. Provide and erect a gutter of 16 ounce cold rolled copper or 18 gauge galvanized steel, under every pipe which is within 2 feet from a vertical line to any motor, electrical controllers, switchboards, panel boards or the like.
   2. Each gutter shall be reinforced, rimmed, soldered and made watertight, properly suspended and pitched to a point outside of the electrical room.

2.8 ACCESS PANELS

A. Furnish access panels for access to plumbing equipment. The sizes of the access panels for hidden valves, cocks and cleanouts in walls and ceilings shall be 12 x 12 inches. The panels shall be factory fabricated completely flush with heavy metal door and frame. Frames shall be welded construction of not less than 14-gauge steel, with heavy piano type hinges set flush with frame, and shall be secured in the closed position. In no case shall opening of the door require removal of nuts, bolts, screws, wing-nuts wedges or any other screwed or loose device. Access panels shall have UL rating, conforming to requirements of area in which it is installed. Access panels shall be Milcor, WayLocktor, Jay R. Smith or equal. Access panels shall be turned over to the General Contractor for installation. Access panels shall not be required in removable tile ceilings. Access panels in fire rated ceilings and/or walls shall have U.L. fire ratings comparable to that location installed.

2.9 SPECIALTIES AND ACCESSORIES

A. Vacuum breakers shall have bronze body and internal trim with high temperature resisting rubber disc and external trim, similar to Chicago, Beacon, Watts #188, or equal. Furnish at hose bibs, wall hydrants and at locations shown on the drawings and governed by code.

2.10 INSULATION

A. All insulation work shall be manufactured by Johns-Manville, Gustin-Bacon, Owens-Corning Fiberglass Corp. or equal, and be executed by a qualified Insulation Sub-contractor who is thoroughly experienced in this type of work, who has adequate facilities and equipment for erecting same; who is acceptable to the Architect. Application and finish on all pipes, fitting and valves shall be as recommended by manufacturer and approved by the Architect. Details shall be submitted for approval. All jackets and adhesives shall be flame retardant. Insulation shall be provided on all piping, valves and fittings in accordance with the International Energy Conservation Code and the requirements of this section.

B. Hot water supply and re-circulating piping:
   1. Piping – 1 inch thick for 1-½ inch piping and larger, ½ inch thick for 1-1/4 inch piping and smaller. Insulation shall be fibrous glass, 3-1/2 pound per cubic foot density minimum sectional pipe insulation with factory applied white All Service Jacket (ASJ) with butt strips and Benjamin-Foster, or equal BF85-75, or longitudinal seams.
   2. Fittings and Valves - shall be insulated with insulation cement or molded fitting insulation to thickness of adjoining insulation finished with two coats of Benjamin-Foster, or equal "Foster Sealfas" 30-36 lagging cloth.

C. Cold water piping:
   1. Piping –½ inch thick for all piping. Insulation shall be fibrous glass, 3-1/2 pound per cubic foot density minimum sectional pipe insulation with factory applied white All Service Jacket (ASJ) with butt strips and Benjamin-Foster, or equal BF85-75, or longitudinal seams. No staples shall be utilized or accepted on the installation of the insulation on cold water piping.
   2. Fittings and Valves - shall be insulated with insulation cement or molded fitting insulation to thickness of adjoining insulation finished with two coats of Benjamin-Foster, or equal "Foster Sealfas" 30-36 lagging cloth.

D. Storm Drain Piping (cast iron): 1/2 inch thick, fibrous glass, 3-1/2 pound per cubic foot density, sectional pipe insulation with a white flame retardant vapor barrier jacket covering all pipe insulation butted. All longitudinal seams and butt seams shall be sealed with Benjamin-Foster, or equal, "Foster Sealfas" 30-36 adhesive and covered with vapor barrier jacket. Storm piping shall be insulated from the roof drain body to the vertical leader to the floor below.

E. All pipe insulation shall have a flame spread rating of 25.

2.11 PIPE LABELS

A. All piping installed by this contractor shall be labeled with plastic adhesive labels. Labels shall indicate the piping system (hot water, hot water recirc, cold water, etc.), and shall indicate the direction of flow. Piping shall be labeled every 20 feet minimum on straight runs and shall be labeled within five feet of changes of direction. Labels shall be applied to the insulation jacket on insulated piping.

2.12 PLUMBING FIXTURES

A. Refer to fixture schedule on design documents for plumbing fixture selections.

B. Mounting heights shall be as shown on architectural details.

C. Fixture installation shall be in accordance with 521 CMR as required.

D. Each individual fixture shall be provided with supply stops for each water service.

2.13HOSE BIBBS

A. Interior hose bibs shall be Woodford Model 24, Josam, Zurn, or equal, chrome plated, vacuum breaker, hose connection, loose T key.

2.14FLOOR CLEANOUTS

A. All floor cleanouts shall be Josam model model 55000-1-SQ series or equal. Floor cleanouts in carpeted areas shall be of the carpet clamping type.

2.15FLOOR DRAINS

A. Furnish and install all floor drains as indicated and required. Drains shall be Josam model 30000 series or equal. All floor drain strainers shall be square shaped style with square grid pattern.

2.16TRAP PRIMERS

A. Furnish and install trap primers for floor drains and sprinkler drain standpipes as indicated and required.

B. Trap primers shall be Precision Plumbing Products ULP-500LP, Jay R. Smith Prime-Eze, or equal, or Mifab M-500 or equal, pressure drop activated, brass with removable filter screen.

C. Multiple trap distribution units shall be Mifab MI-DU or equal to serve two, three or four floor drains.

D. Provide access panels at all trap primer locations if necessary.

2.17WALL HYDRANT

A. Wall hydrant shall be of the non-freeze type equal to Woodford Model 67, 3/4-inch inlet, vacuum breaker, bronze construction, of wall thickness as required. Confirm exterior finishes with architect.

2.18WATER HEATER

A. Furnish and install water heaters as indicated in the water heater schedule.

2.19HOT WATER MIXING VALVE

A. Furnish and install mixing valves as indicated in the mixing valve schedule.

2.20CIRCULATOR PUMP

A. Furnish and install circulator pumps as indicated in the mixing valve schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The plumbing drawings intend to show only the scope of the design, and the Plumbing Contractor shall be responsible for the correct installation of his work in a manner

satisfactory to the best practices of his trade and to complete the scope of this work in all respects.

B. The contractor is responsible for field verifying all existing conditions for connections to existing systems (if any), and shall modify the connection points as necessary based on existing conditions.

C. The location of piping as indicated on the drawings is diagrammatic only, and the exact location shall be determined in the field. The run and arrangement of all pipes shall be approximately as shown on the drawings, as directed during installation, as straight and direct as possible, forming right angles or parallel lines with building wall and other pipes, and neatly spaced. All risers shall be erected true and plumb, parallel with walls and other pipes, and neatly spaced. All horizontal runs of piping except where concealed in partitions, shall be kept as high as possible and close to walls. Wherever possible, adjacent pipe lines, both heating and plumbing, shall be grouped in the same vertical or horizontal planes. All piping shall be concealed and shall have a minimum number of fittings. Piping shall not interfere with the operation or accessibility of doors, windows, access panels, or equipment and shall not encroach on aisles or passageways. All piping shall be installed to preserve access to all valves, traps and equipment.

D. This Contractor shall be responsible for the correctness of field dimensions and shall check for himself all grades, lines, measurements, and other data in any way affecting his work. He shall refer to the project, phasing schedule together with architectural, structural, and drawings of other trades for a full comprehension of the extent of the work to be performed and to avoid interference, and shall not be entitled to any extra compensation for any additional work or expense arising from his failure to do so. In case interference develops, the Architect shall decide which work is to be relocated, regardless of which was first installed. Work installed by the Contractor which is improperly located and/or interferes with or modifies either the phasing schedule or the architectural or structural design, shall be changes as directed by the Architect, and all costs incidental to such changes shall be paid by the Plumbing Contractor.

E. The Plumbing Contractor shall also provide the necessary data and supervision for the provision of all openings in the structure, including bolt hole templates, weights of equipment and manufacturer's recommendations for proper emplacement design. This shall be furnished to the General Contractor and other related trades.

F. No plumbing fixtures, devices, equipment or piping shall be installed which will provide a cross or interconnection be- between a distributing supply for drinking or domestic hot water system and a polluted supply or drainage system. Backflow preventers and vacuum breakers shall be installed where noted on the drawings, and in conjunction with all hydrants, hose bibs, water lines to equipment, water closets, service sinks, and where required to prevent polluted back siphoning.

G. All exposed run outs to equipment, materials and fixtures having chrome plated trim and/or fittings shall be chrome plated brass with chrome plated brass fittings, unless otherwise noted.

3.2 SANITARY AND RAINWATER (STORM) SYSTEMS

A. Interior sanitary and rainwater piping shall pitch in accordance with code requirements, unless otherwise noted.

B. All changes in pipe size and direction on soil and waste piping shall be made with Y's and cleanouts, reducing fittings, recessed reducers. Wyes and 45 degree fittings or 45 degree combination fittings shall be used wherever conditions permit.

C. Sanitary long sweep bends and wyes shall be used for connections to branch lines for fixtures and tee wyes on vertical runs of pipe. Long turn fittings shall be used wherever conditions permit.

D. All fittings, regardless of type, shall be furnished complete with the necessary bolts, nuts and washers, as well as brass or chrome plated nipples of the proper length and wax ring gaskets for the water closet connection.

E. Cleanouts shall be installed where indicated on the drawings, or approximately every 50 ft. along horizontal runs, at all changes in direction, and at the base of all soil, waste and leader stacks. Test tees with brass clean out plugs shall be installed at the base of all vertical piping. No projection above the floor line will be permitted. Cleanouts occurring in or back of walls shall be extended out to finished wall and finished with flush metal access panel. Cleanouts located in floor shall be extended to grade and finished with an access panel. Cleanouts located above hung ceilings are to be made accessible through metal access panels. Running cleanouts may be used where it is impractical to use end cleanouts at base of risers.

F. Each fixture, drain and piece of equipment must be separately trapped unless otherwise noted, and all traps must be vented. All main stacks of back ventilation shall run parallel and as close as possible to the soil stack, and shall connect to the vent continuation of the soil stack at least 3 feet above the highest plumbing fixture on the stack. Horizontal vent lines shall pitch toward a waste line.

G. Fittings for piping above ground shall be drainage patterns.

3.3 DOMESTIC COLD, HOT, AND RE-CIRCULATED HOT WATER PIPING

A. All interior water piping shall be installed without traps or pockets and shall pitch to draw-offs so that the whole system or individual sections can be properly drained. Piping shall have valves and be graded to allow for complete drainage of the system. All draw-off valves shall have hose end which shall be capped. Piping shall be pitched up toward risers and fixtures for proper air relief. Piping subject to expansion shall be flexible and installed to safely absorb all deflection stressed.

3.4 PIPE JOINTS

A. Joints for hub and spigot cast iron soil pipe shall be made with rubber gaskets conforming to State Plumbing Code.

B. Soldered joints on water and waste piping shall be made up using lead-free tin antimony solder, conforming to Federal Spec. QQ-S-571C, and joint shall be filled the full length of the socket. The fitting shall be heated evenly to the proper temperature to run the solder. The ends of the tubing and the inside of the fitting shall be thoroughly cleaned to a bright shining finish before applying flux. Flux shall be non-corrosive type conforming to Fed. Spec. 0-F-506.

3.5 VALVES

A. All piping systems shall be provided with valves so located that they can be operated, replaced, repaired and offer complete control to each group of fixtures, appliance, equipment, and each gas, hot and cold water branch. Each fixture, appliance or piece of equipment shall have a separate shut-off valve, furnished and installed, of approved type, for service to be connected to. Locate valves on supply and return, at each piece of equipment or fixture, each side of regulating valves, each side of pumps, each side of meter, and on main branches. Drain valves on systems containing water shall be installed at the base of each riser (after the shut-off valve), on down- fed fixtures and at equipment, also at such other locations as required to allow for complete drainage of the system. Valves shall be located as shown on the drawings or as here-in-before specified.

3.6 VALVE TAGS

A. Valve tag scheme shall be approved by the Engineer prior to installation in the field and insertion on the record drawings.

B. Contractor shall provide a valve tag chart and clearly label the valve tags on the record drawings. The valve chart shall include but not be limited to: tag #, location, valve type, size and what the valve controls.

C. Valve tags shall be securely fastened to the valve handle by heavy aluminum or brass hooks or chain.

3.7 HANGERS AND SUPPORTS

A. Sanitary piping shall have a hanger at each hub or every 5 feet, whichever is less. Water and gas piping shall be supported at all changes in direction, on branch lines regardless of length, at base and at top of risers. Piping adjacent to floor, where ceiling hangers are impractical, shall be adequately supported by a suitable hanger, as approved by the Architect, with rod to plate at floor, said plate to be secured to floor.

3.8 ACCESS PANELS

A. Access panels shall be turned over to the General Contractor for installation into structure. This Contractor shall direct the General Contractor as to location of access panels.

3.9 SLEEVES

A. Provide sleeves for all piping penetrating new walls, ceilings and floors. Where pipes run through sleeves, the annular openings shall be sealed with fire resistant materials as called for under Part 2 - MATERIALS.

3.10FIRESTOPPING

A. The Contractor shall provide UL listed through penetration fire stopping systems for all penetrations of fire rated floor/ceiling, roof/ceiling and wall assemblies. Coordinate the required UL system with the architectural plans and the material of the piping.

B. Submit each UL listed through penetration fire stopping system to the Architect for review.

3.11TESTING

A. The Plumbing Contractor shall notify the Architect three working days prior to day tests are to be made. Test all piping and make it gas and water tight, in accordance with the authority having jurisdiction and ordinances, and in the presence and to the satisfaction of the applicable Inspector along with the Architect and his representative.

B. No piping shall be buried, concealed or insulated before tested and approved. Partial tests shall be made as required, by the progress of the work, and the Plumbing Contractor shall accommodate the testing operations to the progress of the project. Furnish all equipment, labor, services and apparatuses, and pay for all costs for pertinent tests. All approvals shall be rendered in writing and submitted to the Architect. Remedy all defective work and replace all defective materials, equipment or fixtures with new ones of the specified grade. No caulking, peening, or wicking of screwed joints or holes will be acceptable. This Contractor shall make and remove all temporary piping and line connections required for the tests and shall dispose of test water and all wastes after tests in a satisfactory and non-damaging manner.

C. Piping Systems

1. Upon completion of the roughing in and before setting plumbing fixtures, the entire water piping system shall be tested at a hydrostatic pressure of not less than 150

percent of the maximum working pressure of the system, and shall hold tight at this pressure for 2 hours, without additional pumping. Where a portion of the work is to be concealed before completion, this portion shall be tested separately in the same manner as described for the entire system.

2. Upon roughing in and before setting fixtures, all outlets in soil, waste, rainwater and vent systems shall be temporarily capped and made tight. The piping within the building shall then be filled with water up to the roof and must remain full, without showing any leakage of water. All parts of the system shall be subject to not less than 10 feet of hydrostatic head, above the point being tested. Test tees shall be provided as to facilitate testing.

3.12CLEANING AND STERILIZATION OF SYSTEMS

A. The Plumbing Contractor shall be responsible for the cleaning and purging of all pertinent systems after installation and before system operation. Any damage to part of the building, its finish or furnishings, due to This Contractor's failure to properly clean the system, shall be repaired or replaced, at his expense.

B. All plumbing fixtures shall be thoroughly cleaned of all plaster, sticks, rust stains and other foreign matter or discoloration, leaving every part in an acceptable condition and ready for use. Surfaces shall be cleaned, polished and left bright. The surfaces of all pumps, meters, floor drains, cleanouts, sediment buckets and other equipment shall be cleaned and each items hall be left in a first class condition.

C. All finished metal work shall be cleaned, polished and left bright. All equipment, pipe, valves, drains and fittings shall be cleaned of grease, metal cutting and sludge, which may have accumulated during construction and/or testing.

D. The Plumbing Contractor shall refinish and restore to its original condition all plumbing equipment which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel.

E. The entire new potable water system shall be thoroughly sterilized by the Plumbing Contractor with a solution containing not less than 50 parts per million of available chlorine. The chlorinating materials shall be either liquid chlorine conforming to the requirements of the U.S. Army Spec. No. 4-1 or sodium hypochlorite solution conforming to the requirements of Fed. Spec. O-B-441, Grade D. The sterilizing solution shall be allowed to remain in the system for a period of 8 hours, during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million. Sterilization shall be to the satisfaction of the Board of Health. Submit certification, in writing, that this work has been accomplished in conformance with the above.

END OF SECTION

SECTION 230000

HVAC

(FILED SUB-BID REQUIRED)

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

A. The BIDDING REQUIREMENTS, CONTRACT FORMS, and Contract Conditions as listed in the Table of Contents, and applicable parts of Division 1 - GENERAL REQUIREMENTS, shall be included in and made a part of this Section.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section. The listing of Contract Drawings above does not limit Filed Subcontractor's responsibility to determine full extent of work of this Section as required by all Drawings listed in the Drawing List on the Drawing Title Sheet, as modified by Addenda.

C. Refer to Section 01 23 00 - Alternates, for alternates which may affect the scope of Work of this Section.

1.2 WORK INCLUDED

A. The work included in the Heating, Ventilating and Air Conditioning specifications consists of furnishing all materials, labor, equipment and appurtenances to perform, and leave in satisfactory operating condition the new systems.

B. It is the intention of these specifications to call for finished work, fully tested and ready for continuous operation. Any apparatus, equipment, material or work not mentioned in the specifications or incidental accessories to make the work completely balanced, perfect in all respects and ready for operation, even if not specifically mentioned, shall be furnished, tested, adjusted or balanced at no additional expense to the Owner. Should there appear to be discrepancies or questions of intent, the Sub-Contractors shall refer the matter to the Architect for decision before start of any related work.

C. The drawings, where applicable, show equipment and device locations, required flows at those devices and locations of new thermostats and controls. In addition, the drawings identify routing for new ducting and new piping as well as their respective sizes. The HVAC Sub-Contractor shall field verify that the routing is free of obstacles and other trades work.

D. The Contractor shall confer and cooperate with all other building trades so that all work will be installed in the proper relationship to all other work.

E. The Contractor shall provide and maintain all staging, scaffolding, ladders and hoisting equipment required for the execution of the work by his personnel. Remove same from premises when no longer required.

1. Coordinate with Division 1 for which staging will be provided by the General Contractor.

F. The work under this section shall include furnishing all motor starters and components for installation by the electrical sub-contractor.

G. The work under this section shall include all labor, materials, accessories, services, and equipment necessary to furnish and install:

1. All pipe guides, supports, hangers and anchors.
2. All vibration isolation equipment, bases and devices.
    a. Unless otherwise noted on the equipment schedule, all mechanical equipment shall

be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflection. Deflections shall be as noted on the equipment schedule or those required to provide 98% isolation efficiency.

3. All insulation of all parts of the condensate system including all pipe, fittings, pipe flanges, valves, expansion joints, vents, drains, etc. which may be subject to thermal losses adverse to the operation of the various systems, or which may sweat.
4. All insulation of all parts of the supply and outdoor air intake duct systems including all duct, fittings, flanges, dampers, etc. which may be subject to thermal losses adverse to the operation of the various systems, or which may sweat.
5. All refrigeration piping and insulation.
6. All filters and air cleaning equipment.
7. All ductwork.
8. All duct fittings.
9. All ductwork accessories.
10. All motorized dampers.
11. All constant volume regulators.
12. All air inlet and outlet equipment.
13. All louvers.
14. All fan coil units.
15. All variable refrigerant volume heat pump systems.
16. All energy recovery units.
17. All air handling units.
18. All fans.
19. All air curtains.
20. All electric heating devices.
21. All control system components to provide a fully operational automatic temperature control system.
22. All Testing, Adjusting and Balancing of all components of the HVAC systems.
23. All HVAC commissioning requirements in Section 019113 – General Commissioning Requirements.
24. All requirements for the project's participation in the Eversource Path 1 Net Zero Equivalent (NZE) rebate program for new buildings.
25. All firestopping.

H. The following work is not included in this section and will be provided under other sections, except as specified herein:

1. Electrical wiring for all equipment
2. Structural supports necessary to distribute loading equipment to roof or floor
3. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing. Refer to Division I, General Conditions.
4. Excavation and backfill
5. Concrete work including concrete housekeeping pads and blocks for vibrating and rotating equipment, and cast-in-place manholes

6. Flashing roof and wall penetrations
7. Painting

I. The Contractor shall coordinate their scope of work with requirements as noted on architectural drawings.

1.3 DEFINITIONS

A. Where used in this specification, the following definitions shall apply:

1. "Test" means to determine quantitative performance of HVAC equipment.
2. "Adjust" means to produce the specified fluid at the terminal equipment.
3. "Balance" means to establish the specified air flows within the distribution systems.
4. "Procedure" is the standardized approach and execution of sequence of work operations to yield reproducible results.
5. Report forms shall be test data sheets arranged for collection of test data in logical order for submission and review. These data shall form the permanent record which shall be used as the basis for any future testing, adjusting, and balancing required.
6. The testing, adjusting, and balancing Sub-Contractor shall hereinafter be referred to as "The TAB Sub-Contractor", who shall be a subcontractor to the HVAC sub-contractor.
7. Where specifications refer to SMACNA standards, the SMACNA standards shall be considered as the minimum acceptable. If local codes require other standards than the local codes shall govern.
8. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories and all other items required for a proper and complete installation.
9. "Concealed" shall mean hidden from sight in chases, furred in spaces, shafts, embedded in construction, in a crawl space, and above hung ceilings.
10. "Exposed" shall mean not installed underground or concealed as defined above.
11. "Furnish" shall mean purchase and deliver to the project site, complete with every necessary appearance and support.
12. "Install" shall mean unload at the delivery point at the site and perform all work necessary to establish secure mounting, proper location and operation in the project.
13. "Provide" shall mean furnish and install.
14. "Piping" shall mean, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.
15. "Furnished by others" shall mean materials or equipment purchased and set in place under other sections of the general contract and connected to the systems covered by this section of the specifications by the HVAC Sub-Contractor.
16. "Coordinate" shall mean all work provided under this section of the specification shall be in compliance with the work of other trades.
17. "HVAC Subcontractor," "Subcontractor," or "Installing Contractor" shall be the Subcontractor responsible for the work of this section of the specifications, and shall be responsible for coordination of the work of this section.
18. "ATC" shall mean Automatic Temperature Controls, and shall be interchangeable with Building Automation System (BAS) and Building Management System (BMS).
19. "Owner's Representative" shall be the party responsible to make decisions regarding all contractual obligations in reference to the Scope of Work for the Owner.

20. The “Sheetmetal Sub-Contractor” shall herein after be responsible for the sheetmetal work of this section.
21. The “TAB Sub-Contractor” shall herein after be responsible for the balancing work of this section.
22. The “ATC Sub-Contractor” shall herein after be responsible for the ATC work of this section.

1.4 GENERAL REQUIREMENTS FOR SHEETMETAL DUCTWORK

A. Where specifications refer to SMACNA standards, the SMACNA standards shall be considered as the minimum acceptable. If local codes require other standards, then the local codes shall govern.

B. All ductwork indicated on the drawings is to be considered as shown in schematic. Changes in duct size to clear obstructions or to accommodate field conditions caused by the work of other trades, not shown on the drawings, shall be made, where necessary to conform to the actual space conditions and shall be provided at no additional cost to the owner. No duct changes shall be fabricated until after written approval of the modified or original shop drawings by the Engineer.

C. It shall be the Sub-Contractor’s responsibility to field verify all dimensions and to coordinate his work with the work of other trades. Locations and placement of ducts shall be coordinated with the work of the other trades before any ductwork is fabricated or installed.

D. Each duct system shall be constructed for the specific duct pressures and/or pressure classifications shown on or required by the contract drawings. Where no specific duct pressure or class designation is shown the SMACNA 2” W.G. pressure class is the basis for compliance with these standards.

1.5 EXAMINATION OF SITE AND DOCUMENTS

A. Bidders are expected to examine and to be thoroughly familiar with all contract documents and with the conditions under which work will be carried out. The Awarding Authority (Owner) will not be responsible for errors, omissions and/or charges for extra work arising from General Contractor's or Filed subcontractor's failure to familiarize themselves with the Contract Documents or existing conditions. By submitting a bid, the Bidder agrees and warrants that he has had the opportunity to examine the site and the Contract Documents, that he is familiar with the conditions and requirements of both and where they require, in any part of the work a given result to be produced, that the Contract Documents are adequate and that he will produce the required results.

1.6 RELATED WORK IN OTHER SECTIONS

A. The following is a list of related work to be performed or furnished by other trades under other sections of the specifications:

1. Electrical power wiring.
2. Grillage and miscellaneous structural elements to fully support and/or suspend the HVAC equipment.
3. Access Panels (other than duct access panels) – filed sub-bid contractor to provide sizes to General Contractor. General Contractor to purchase and install.

1.7 PRODUCTS FURNISHED, BUT NOT INSTALLED UNDER THIS SECTION

A. Furnish line voltage fan speed control switches and line voltage thermostats for installation by the Electrical Subcontractor.

B. All motors for HVAC equipment shall be furnished and set under this section. All motor starters shall be provided by the HVAC Sub-Contractor for installation by the Electrical Contractor. All controls shall be provided and installed by the ATC Sub-Contractor. All control wiring shall be provided and installed by the ATC Sub-Contractor in accordance with the applicable provisions of the electrical specifications.

1.8 INSTALLED, BUT NOT FURNISHED UNDER THIS SECTION

A. N/A

1.9 CODES AND STANDARDS

A. Materials, installation of systems and equipment provided under this section shall be done in strict accordance with the latest governing edition of the following standards, codes, specifications, requirements, and regulations, and any ‘other Codes-and Regulations having jurisdiction including but not limited to:

1. All applicable NFPA Standards
2. State and Local Building, Mechanical, Electrical and Energy Codes
3. American Society of Mechanical Engineers (ASME)
4. American Society of Testing and Materials (ASTM)
5. American National Standards Institute (ANSI)
6. Underwriters Laboratories, Inc. (UL)
7. Occupational Safety and Health Administration (OSHA)
8. Any other ‘local codes’ or authorities having jurisdiction

B. Heating, pumping, sheetmetal and refrigeration systems shall be installed by contractors and personnel appropriately licensed in the State (Installing Contractor).

C. Electrical and automatic temperature control wiring shall be done in accordance with applicable codes by licensed electricians.

D. All equipment shall meet the more efficient requirements:

1. As shown on bid documents, or
2. Minimum efficiencies stated in the governing Energy Code.

E. Unless otherwise specified or indicated, materials, workmanship and equipment performance shall conform with the latest governing edition of the following standards, codes, specifications, requirements and regulations, except when more rigid requirements are specified or are required by applicable codes but not limited to:

1. Air Conditioning and Refrigeration Institute (ARI)
2. Air Diffusion Council (ADC)
3. Air Movement and Control Association (AMCA)
4. American Boiler Manufacturers Association (ABMA)
5. American National Standards Institute (ANSI)
6. American Petroleum Institute (API)

7. American Society of Heating, Refrigeration and Air Conditioning (ASHRAE)
8. American Society of Mechanical Engineers (ASME)
9. American Society of Testing and Materials (ASTM)
10. American Welding Society, Inc. (AWS)
11. Associated Air Balance Council (AABC)
12. Copper Development Association (CDA)
13. Expansion Joint Manufacturers Association, Inc. (EJMA)
14. Factory Mutual System (FM)
15. Institute of Electrical and Electronics Engineers (IEEE)
16. Manufacturer's Standardization Society of the Valve & Fitting Industry (MSS)
17. National Electric Manufacturers-Association (NEMA)
18. National Environmental Balancing Bureau (NEBS)
19. The Hydronics Institute (HI)

F. The date of the code or standard is that in effect at the Bid Date.

G. Give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from authorities having jurisdiction. Deliver all certificates of inspection to the authorities having jurisdiction. No work shall be covered before examination and approval by the Owner's Representative, inspectors, and authorities having jurisdiction. Replace imperfect or condemned work to conform to requirements, satisfactory to Owner's Representative, and without extra cost to the owner. If work is covered before inspection and approval, the HVAC Sub-Contractor shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

1.10 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. It is the intention of the Specifications and Drawings to call for complete, finished work, tested and ready for continuous operation. Any apparatus, appliance, material or work not shown on the Drawings, but mentioned in the Specifications or vice versa, or any incidental accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be provided by the HVAC Sub-Contractor or his/her Sub-subcontractors, without additional expense to the Owner.

B. The drawings are generally diagrammatic. The locations of all items that are not definitely fixed by dimensions are approximate only. The exact locations must be determined at the site and shall have the approval of the Architect-before being installed. The HVAC Sub-Contractor and related Sub-Contractors shall follow Drawings, including shop drawings, in laying out work and shall check the Drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions. Where space conditions appear inadequate, notify the Architect before proceeding with the installation. The HVAC Sub-Contractor and related Sub-Contractors shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

C. Sizes of ducts and pipes and routing are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered. To carry out the intent and purpose of the Drawings, all necessary parts to make complete approved working systems ready for use, shall be furnished without extra charge.

1.11 SURVEY AND MEASUREMENTS

A. Base all required measurements, horizontal and vertical, from referenced points established with the Owner's Representative and be responsible for correctly laying out the Work required under this Section of the Specification.

B. In the event of discrepancy between actual measurements and those indicated, notify the Owner's Representative in writing and do not proceed with the related work until instructions have been issued.

1.12 COORDINATION WITH OTHER BUILDING TRADES

A. Structural members and building openings for HVAC equipment, ducts, piping, fans, etc., for use by the HVAC Sub-Contractor shown on the architectural or structural plans are the coordination responsibility of the HVAC Sub-Contractor.

B. The work shall be so performed that the progress of the entire building construction, including all other trades, shall not be delayed or interfered with. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as required.

C. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other sections. Any conflicts shall be referred immediately to the Owner's Representative for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Owner's Representative's satisfaction at no expense to the Owner.

D. Where work of this section will be installed in close proximity to work of other sections or where there is evidence that the work of this section may interfere with work of other sections, assist in working out space conditions to make satisfactory adjustment. Prepare and submit for approval 3/8" scale or larger working drawings and sections, clearly showing how the work is to be installed in relation to the work of other sections. If the work of this section is installed before coordinating with other trades or so as to cause interference with work of other trades, make changes necessary to protect conditions without extra charge.

E. Keep fully informed as to the shape, size and position of all opening s required for all apparatus, piping, ductwork, etc., and give information in advance to build openings into the work. Furnish all sleeves, pockets, supports and incidentals, and coordinate with the Owner's Representative for the proper setting of same.

F. All distribution systems which require pitch or slope such as condensate drains and water piping shall have the right of way over those which do not.

G. The HVAC Sub-Contractor shall, with the approval of the Architect and without extra charge, make reasonable modifications in his work as required by normal structural interferences, or by interference with work of other trades, or for proper execution of the work.

H. Keep fully informed as to the size, shape and location of all openings required for the work of this Section and give full information to all Contractors and Sub-Contractors and the Owner's Representative.

I. Structural Concrete Coordination Drawings

1. Contractor shall prepare and submit ¼" scale plan slab layout drawings clearly dimensioning all openings, sleeves, inserts, embedded pipes and conduits, embedded plates, etc. required for the mechanical, electrical and plumbing trades.
2. Where embedded items are to be placed in column or wall pours, similar elevation drawings shall also be submitted.
3. Submittals shall be made for review by both the Architect and Structural engineer and made not less than six weeks prior to the date of concrete placement for a given slab level or column wall story level.

1.13 GENERAL REQUIREMENTS

A. Nameplates

1. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, type or style, model number, catalog number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

B. Maintenance Information

1. Systems and equipment which require periodic maintenance to maintain efficient operation shall be furnished with complete necessary maintenance information. Required routine maintenance actions, as specified by the manufacturer, shall be stated clearly and incorporated on a readily accessible label on the equipment. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product.

C. Equipment Guards

1. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

1.14 FEES AND PERMITS

A. The HVAC Sub-Contractor and related Sub-Contractors shall apply for, obtain and pay for all required permits, inspections, certificates, and incidental charges required for proper performance of the work, and shall furnish the Architect with copies of applications and all correspondence.

1.15 MATERIAL AND EQUIPMENT STANDARDS

A. Where equipment or materials are specified with the name of a manufacturer, such specifications shall be deemed to be used for the purpose of establishing a standard for that particular item. No equipment or material shall be used unless previously approved by the Owner's Representative.

B. Substitutions (approved equals) may be offered for review provided the material, equipment or process offered for consideration, is equal in every respect to that indicated or specified. In order for requests for substitution to be considered, all must be submitted for pre-approval of manufacturer within 30 days of award of contract. All requests must be accompanied by a list of minimum 5-year-old successful installations of similar scope (with owner contact and phone number), complete specifications together with drawings or

samples to properly appraise the materials, equipment or process. Allow 30 days for Owner's Representative's review.

C. If a substitution of materials or equipment in whole or in part is made, this HVAC Sub-Contractor shall bear the cost of any changes necessitated by any other trade as a result of said substitution.

D. All materials, equipment and accessories provided under this section shall be new and unused products of recognized manufacturers as approved.

1.16 SHOP DRAWINGS AND SUBMITTALS

A. Conform to the requirements of Division I, General Conditions, for schedule and form of all submittals unless specifically noted otherwise in this section. Coordinate this submittal with submittals for all other finishes. Shop drawings and design layouts shall be prepared by licensed installing contractors and shall note the name(s), license number(s) and license expiration date(s) of the contractor(s) installing the heating, piping, and refrigeration systems.

B. Provide any additional submittals not noted below that may be required for confirmation of conformance with the requirements of all applicable Energy Rebate programs.

C. Definitions:

1. Shop drawings are information prepared by the HVAC Sub-Contractor to illustrate portions of the work in more detail than indicated in the Contract Documents.
2. Acceptable Manufacturers: The mechanical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. In Part 2 of the specifications certain Alternate Manufacturers are listed as being acceptable. In addition, the MATERIAL AND EQUIPMENT STANDARDS paragraph potentially allows for substitutions as being acceptable. These are acceptable only if, as a minimum, they:
   a. Meet all performance criteria listed in the schedules and outlined in the specifications. For example, to be acceptable, a fan coil unit must deliver equal CFM against equal external static pressure (with the allowed pressure drop of dirty filters) using equal or less horsepower as the fan coil unit listed in the schedules.
   b. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings, and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean the Engineer has determined that the manufacturer's products will fit within the available space this determination is solely the responsibility of the HVAC Sub-Contractor.
   c. For rooftop mounted equipment and equipment mounted in areas where structural matters are a concern, the products must have a weight no greater than the product listed in the schedules or specifications.
   d. Products must adhere to all architectural considerations including, but not limited to: being of the same color as the product scheduled or specified, fitting within the architectural enclosures and details, and for diffusers – being the same size and of the same physical appearance as scheduled or specified products.

3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

D. Submittal Procedures, Format and Requirements

1. Shop drawings showing manufacturer's product data shall contain detailed dimensional drawings (minimum ¼" scale) including plans and sections (where physical clearance could be an issue). Provide larger scale details as necessary. Sheet metal drawings shall show elements of Architect's reflected ceiling plan, exposed ductwork, walls and partitions (highlighting fire walls and smoke partitions), diffusers, registers, grilles, fire and smoke dampers, sleeves and other aspects of construction as necessary for coordination.
2. Submit accurate and complete description of materials of construction, manufacturer's published performance characteristics, sizes, weights, capacity ratings (performance data, alone, is not acceptable), electrical requirements, starting characteristics, wiring diagrams, and acoustical performance for complete assemblies. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.
3. If shop drawings showing connection details are not submitted and connections are found to be installed incorrectly, the HVAC Sub-Contractor shall reinstall them within the original contract price.
4. Provide complete data for all auxiliary services and utilities required by submitted equipment. This shall include power, condenser or cooling water, condensate and compressed air requirements and points of connection.
5. Provide a complete description of all controls and instrumentation required, including electrical power connection drawing for all components and interconnection wiring to starters, detailed information on starters, control diagrams, termination diagrams, and all control interfaces with a central control system.
6. Provide installation and erection information including; lifting requirements, and any special rigging or installation requirements for all equipment.
7. The Owner's Representative shall approve all materials before commitment for materials is made.

E. Product Data: Submit complete manufacturer's product description and technical information including:

1. Piping and Fittings (all systems, types and joining methods)
2. Pipe Hangers and Supports
3. Fan Coil units
4. Variable refrigerant volume heat pump systems
5. Energy recovery units
6. VAV boxes
7. Ceiling exhaust fans
8. Identification
9. Sleeves
10. Firestopping materials
11. Valves and Accessories (all types)

12. Pipe Insulation
13. Electric Motors and Starters
14. Refrigerant and Oil
15. Equipment Nameplates
16. Vibration Isolation equipment
17. Complete ductwork, equipment layout, and shop drawings, construction details and construction standards
18. Motorized dampers
19. Duct Insulation
20. Diffusers, Registers and Grilles
21. Air Filters
22. Fans
23. Electric heating devices
24. Operating and maintenance instructions and manuals
25. HVAC Control Systems
26. Color selection charts and samples for equipment and systems in finished areas. (Provide six (6) original hard copies from manufacturer, electronic files are not acceptable.)

F. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in an individual (combined) submittal with a screwed together post binding system. Three-ring binders shall not be accepted.

G. Substitution Requests: Submit four copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution: A submittal shall be considered a substitution when the Engineer/Architect does not accept the product or material as an “equivalent” or where one of the listed manufacturers is not submitted.
2. Substitution Requirements: Substitutions shall meet the requirements of “Comparable Products.”
3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
   a. Statement indicating why specified material or product cannot be provided.
   b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
   c. Detailed comparison of significant qualities of proposed substitution with those of the Project scope of work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
   e. Samples, where applicable or requested.
   f. Cost information, including a proposal of change, if any, in the Contract Sum.
   g. Contractor's certification that proposed substitution complies with requirements in

the Contract Documents and is appropriate for applications indicated.

h. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

i. Statement indicating why the requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations.

H. Deviations

1. Proposed deviations from the Contract Documents, other than substitutions, shall be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Architect.
2. Without letters flagging the deviation, it is possible that the Architect may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Owner's Representative, the Seller shall hold the Architect, his consultants and the Owner harmless for any and all adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Architect has reviewed or approved shop drawings containing the deviation, and will be strictly enforced.
3. Approval of proposed deviations, if any, will be made at discretion of Architect.

I. Schedule: Incorporate shop drawing review period into construction schedule so that work is not delayed. The HVAC Sub-Contractor shall assume full responsibility for delays caused by not incorporating the following shop drawing review time requirements into his project schedule:

1. Allow at least 10 working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted with the exception that 20 working days, exclusive of transmittal time are required for the following:
   a. HVAC temperature control submittals
   b. HVAC balancing report
   c. Coordination drawings
   d. If more than five shop drawings of a single trade are received in one calendar week.
2. All roof mounted equipment submittals shall be considered a critical path item for coordination with structural shop drawings.

J. Responsibility

1. Intent of submittal review is to check for capacity, rating and certain construction features. HVAC Sub-Contractor shall ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes' or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other sections. Work shall comply with approved submittals to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor the shop drawing errors or deviations from requirements of Contract Documents. The Engineer's noting of some errors while overlooking others will not excuse the HVAC Sub-Contractor from proceeding in error. Contract Documents requirements are not limited, waived nor superseded in any way by review.

2. Inform sub-contractors, manufacturer's suppliers, etc. Of scope and limited nature of review process and enforce compliance with contract documents.

K. In the event that the HVAC Sub-Contractor fails to provide Shop Drawings for any of the products specified herein:

1. The HVAC Sub-Contractor shall furnish and install all materials and equipment herein specified in complete accordance with these Specifications.
2. If the HVAC Sub-Contractor furnishes and installs material and/or equipment that are not in complete accordance with these Specifications, he shall be responsible for the removal of this material and/or equipment. He shall also be responsible for the replacement of this material and/or equipment with material and/or equipment that is in complete accordance with these Specifications, at the direction of the Owner's Representative.
3. Removal and replacement of materials and/or equipment that are not in complete compliance with these Specifications shall be done at no extra cost to the Owner.
4. Removal and replacement of materials and/or equipment that are not in complete compliance with these Specifications shall not be allowed as a basis for a claim of delay of completion of the Work.

L. Mark dimensions and values in units to match those specified.

M. Submit Material Safety Data Sheets (MSD) on each applicable product with submittal.

1.17 APPROVAL OF SUBMITTALS

A. The Architect will return signed and approved or disapproved submittals to the Contractor within the time allowed by other sections of the specifications. Any submittals, which have been disapproved, shall be resubmitted by the Contractor within the time allowed by other sections of the specifications.

1.18 RESPONSIBILITY FOR ACCURACY OF SUBMITTALS

A. The HVAC Sub-Contractor is solely responsible for the accuracy and completeness of all submittals, regardless of corrections made in, or approval given to, such submittals. When the Architect makes comments and returns the submittals, it is incumbent upon the HVAC Sub-Contractor to thoroughly review the comments and notations made by the Architect. When, in the HVAC Sub-Contractor's opinion, the notes made by the Architect are in error or in conflict with other elements of the system, it is incumbent upon the HVAC Sub-Contractor to promptly notify the Architect of his findings or opinion along with substantiating data, in writing to preclude misunderstanding or expensive alterations caused by a review error or oversight. The submittals are intended to provide detailed documentation of the system design and its components. The responsibility for their correctness rests completely, totally and solely with the HVAC Sub-Contractor.

1.19 SUBSTITUTION OF MATERIALS OR EQUIPMENT

A. Named manufacturers for any equipment specified herein or identified on the drawings are identified for the purpose of identifying quality standards, performance information or type. Any substitution as "or equal" shall be considered. The Architect shall determine whether or not the offered equipment is equal to the specified. Where dimensional constraints exist the HVAC Sub-Contractor shall be responsible for any extra costs associated with extra work required to make the "or equal" equipment fit.

B. After approval of the submittals, substitution of materials or equipment of makes other than those specifically named in the submittals will be approved by the Architect only if the material or equipment proposed for substitution is equal to and/or superior to material or equipment named in construction, efficiency, utility and accuracy; and further that the material or equipment named in the submittals cannot be delivered to the job in proper sequence due to conditions beyond the control of the HVAC Sub-Contractor.

C. To receive consideration, requests for substitution shall be accompanied by documentary proof of equality or difference of both proposed equipment to be substituted and equipment named in the approved submittals. Substitution by the HVAC Sub-Contractor of other materials or processes than those named in the approved submittals shall be done only upon written authorization from the Architect.

D. Substitutions of fans shall have noise ratings that are equal to or better than the specified units. The substituted equipment shall be provided with the sound power data for both the substituted and specified equipment graphed on an NC curve chart for review with the submittal.

E. The requirements of Sections 013300 & 013301 shall be followed.

1.20 PRODUCT INTEROPERABILITY REQUIREMENTS

A. Interoperability Coordination Meeting: Attend coordination meetings to coordinate interoperability between all systems and equipment. Meetings shall be scheduled by the construction manager.

B. General Networking and Protocol Interoperability Requirements: Provide products that are fully BACNet interoperable.

1. All systems and equipment shall interface with the primary building management network provided under "Instrumentation and Controls for HVAC" using Ethernet standards and BACNet protocol.
2. Equipment that is native BACNet may connect directly to a BACNet MS/TP subnet that is provided by "Instrumentation and Controls for HVAC" when coordinated with that Section Contractor.
3. Communication involving control components (i.e., all types of controllers and operator interfaces) shall conform to the most current ANSI/ASHRAE Standard 135, BACnet.
4. The MS/TP trunks support all of the ASHRAE 135 approved baud rates.
5. All MS/TP devices support all baud rates of the ASHRAE 135.
6. All MS/TP devices shall be BTL approved (BACnet Testing Lab).
7. All BACnet routers must support B-BC (BIBB) and support BBMD routing.
8. Lonworks and Modbus subnets may be utilized where no BACNet protocol is available provided full 2-way compatibility is provided through a gateway.
    a. Exception: Fire alarm systems shall be 1-way, read only communication.
9. Each individual system and/or equipment manufacturer/installer shall provide all necessary gateways/translators Provide Gateway with all products as required facilitating full BACNet interoperability with BACNet Protocol.
10. It must be possible to read and display the value of any property, including all required properties, supported optional properties, and proprietary extensions of very object of every networked device.

11. Operating setpoints and parameters must be available for modification via BACnet services via a graphical user interface (GUI).
12. An operator shall be able to display at any time the operational status of any device on the BACnet internetwork. An operator shall be able to display at any time any property of any BACnet object. An operator shall also be able to display property values of objects grouped by object type, object location, building system, and by user defined parameters.
13. An operator shall have the ability to issue re-initialization commands to any device that supports remote re-initialization.
14. An operator shall have the ability to backup and restore all BACnet devices on the network.
15. It shall be each contractor's responsibility to configure each router using the network numbering scheme for the project. Each router shall be configured such that all network layer error messages shall be directed to a specific workstation using the BACnet Confirmed Text Message service. It shall be the contractor's responsibility to initially configure each router with routing tables containing all network numbers that are part of the project's internet. The router shall be able to receive messages at each port of any length that is valid for the LAN technology connected to that port, and to forward the message to any directly-connected network that can convey a message of that size.
16. Legacy Systems: Bi-directional gateways shall be provided for systems and equipment operating on a legacy/proprietary system. The operator workstation shall display information from both the BACnet and non-BACnet devices. Any information specified or required for system functionality shall be made readable and modifiable. Gateways shall have 10% expansion capacity. Gateways shall support archiving, uploading, trending, scheduling, and alarm/event detection, notification and acknowledgement.
17. Systems and equipment shall have full 2- way communications and interoperability.
    a. Exception: Fire safety systems and equipment shall have only read access to outside systems:
        1 Fire alarm.
18. Coordinate with "Instrumentation and Controls for HVAC" and other building operational systems for specific interoperability requirements.

C. Communications Standard: Coordinate communications standards requirements with other Sections and Divisions.
    1. MS/TP LAN: RS 485
    2. Systems with dedicated network(s) shall connect on the BACNet Ethernet LAN: utilizing a switch and shall meet standard Ethernet requirements.
        a. Utilize RJ-45 terminations.
        b. Utilize CAT 6 cabling.
        c. Meet IEEE Standard 802.3 standards and requirements.
        d. Speed: 100 Mbps.
    3. Equipment without dedicated networks shall connect to the BACNet MS/TP LAN.
        a. RS 485 communications standard.
        b. Speed: 1 Mbps.

D. Information Availability: Make all product information, points, variables, setpoints, etc., available for access of building operational systems upon request.
    1. Provide bi-directional point mapping/addressing instructions.

2. Provide on-site technicians as required to ensure proper information exchange.

E. Factory Provided Equipment Controllers: Provide all information, points, variables, setpoints, etc., indicated and referenced in all documentation, including "Instrumentation and Controls for HVAC." Products shall have full interoperability as indicated in this Section, in BACNet standards and elsewhere.

1.21 COORDINATION DRAWINGS

A. Before materials are purchased or work is begun, prepare coordination drawings showing the size and location of equipment, piping, etc., in the manner described under SUPPLEMENTARY CONDITIONS.

B. Coordination drawings are for the General Contractor's and the Architect's use during construction and shall not be construed as replacing any shop, "as-built" or record drawings required elsewhere in these contract documents.

C. The HVAC Sub-Contractor shall be responsible for initiating the preparation of the coordination drawings and passing the drawings to other trades through the General Contractor for addition of the other trade's work.

1. Coordinated reflected ceiling plans showing ceiling mounted fan coil locations shall be included.

D. HVAC Coordination drawings shall show the following:

1. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
2. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
3. Fire-rated enclosures around ductwork.

E. Before work progresses, and in addition to the shop drawings listed herein, submit coordination drawings at a suitable scale of not less than 3/8 inches equals one foot.

F. Coordination Digital Data Files: Prepare coordination digital data files in accordance with the following requirements:

1. File Preparation Format: Autodesk Revit .rvt file format in Microsoft Windows operating system and Autodesk AutoCAD .dwg file format in Microsoft Windows operating system.
2. File Submittal Format: Submit or post coordination digital data files in the file preparation format and in Adobe .pdf format.
3. Upon receipt of a signed release form, Engineer/Architect will furnish to the Contractor one set of digital data files for use in preparing coordination digital data files.
   a. Engineer/Architect makes no representations as to the accuracy or completeness of digital data files as they relate to the drawings.
   b. Contractor shall execute a data licensing agreement

G. Provide composite systems coordination drawings showing HVAC duct, piping and equipment, fire protection piping and equipment, plumbing pipe and equipment and electrical conduit, cable, lights and other equipment.

H. All trades are required to coordinate with the other trades and revise the composite systems coordination drawings to eliminate interferences.

1.22 RECORD DRAWINGS

A. The Architect will furnish the HVAC Sub-Contractor electronic files of the mechanical drawings as issued for this contract in AutoCAD format and current Revit model file (if available). The HVAC Sub-Contractor shall change these drawings to indicate accurately and neatly the actual duct routing and duct sizes. At the end of the project the HVAC Sub-Contractor shall deliver to the Architect one set of reproducible As-built drawings and two (2) Compact Disks or USB flash drives with As-Built drawing files in the current AutoCAD version format and the current Revit version for the owner's permanent record.

B. The "As-Built" drawings shall show:

1. The actual location of all air volume dampers and actuators.
2. The actual location of all control valves and isolation valves with valve tag numbers
3. Valve tag charts
4. The actual location of all thermostats and control sensors.
5. The actual location of all access panels
6. Equipment schedules of the installed equipment.

1.23 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Commence preparation of the Operating and Maintenance manuals immediately upon receipt of "Approved" or "Approved as Noted" shop drawings and submit each section within one month. The last submission shall be no later than two months prior to the date of Substantial Completion of the project.

B. The manual shall consist of (3) sets of manuals and include (3) CDs, which shall contain the scanned content of the entire manual. The manual shall be submitted for review prior to creation of the CDs.

C. The manual shall contain the following:

1. Operations Manual
   a. Systems description including all-relevant information needed for day-to-day operations and management including start-up and shut-down instructions.
   b. Wiring diagrams, schematics, logic diagrams and sequence of operations that accurately depict the controls system.
   c. Depiction of each interface screen where programmable logic and visual displays are provided. Descriptors shall be provided to define displayed data; alarms, etc.
   d. A single sheet (for ease of removal) of all access codes and passwords necessary to access all levels of control and programming.
   e. Trouble shooting guide defining common alarms/problems with possible cause and effect.
2. Maintenance Manual
   a. Define all maintenance activities required to ensure system operation within manufacturers' specified parameters. Provide table of all required activities plotted vs. interval with adequate fill-in-space for "activity completion date" and "comments". Where multiple instrument readings are required, provide data sheet formatted to accommodate activity.
   b. Provide as part of each package, lubricating charts indicating equipment tag number, location, equipment service, greasing and lubricating requirements,

lubricants, and intervals.

c. Provide as part of each package, a valve and system chart that corresponds to the valve tags. Provide directions for normal positions and positions for equipment failure modes.

d. The HVAC Sub-Contractor shall furnish spare-parts data for each different item of equipment furnished. The data shall include a complete list of: parts and supplies, with current unit prices, lead time, and source of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified herein after to be furnished as part of the contract; and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 360 days at the particular installation. The foregoing shall not relieve the HVAC Sub-Contractor of any responsibilities under the guarantees specified herein.

e. Provide copy of all warranty information with associated date of substantial completion (commencement of warranty) and end date of coverage. Define all components/subsystems specifically included and excluded.

D. Provide O&M manuals for each of the following as a minimum:

1. Electric Motors and Starters
2. Energy recovery units
3. Fan coil units
4. Variable refrigerant volume systems
5. VAV Boxes
6. Constant volume regulators
7. Vibration Isolation
8. Air Filters
9. Fans
10. Electric heating devices
11. Equipment support stands
12. Vibration isolation devices
13. Control Systems and components

1.24 WARRANTIES

A. Submit manufacturers standard replacement warranties for material and equipment furnished under this Section. Such warranties shall be in addition to and not in lieu of all liabilities which the manufacturer and the HVAC Sub-Contractor and related Sub-Contractors may have by law or by provisions of the Contract Documents.

B. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the Drawings.

C. Upon receipt of notice from the Owner of the failure of any part of the systems during the guarantee period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be replaced.

1.25 SYSTEM TRAINING

A. The HVAC Sub-Contractor shall provide on-site training on the mechanical systems for the building. The amount of time provided shall be as indicated below. Training times and dates

shall be coordinated with the Owner. The training shall be video recorded by the HVAC Sub-Contractor and a DVD shall be provided to the Owner with each of the O&M Manuals.

B. Training shall include but not be limited to:

1. A general overview of the operation of each system (provide 4 hours)
2. The Variable refrigerant volume heat pump system and controls (provide 4 hours)
3. The energy recovery ventilators and fresh air system (provide 4 hours)
4. The ATC system and scheduling. (provide 4 hours)
5. Any other topics related to the mechanical system as requested by the Owner (provide 4 hours).

C. The variable refrigerant volume heat pump system shall include training by a manufacturer approved representative, a minimum of four hours and 4 hours of standard structured off-site training at the manufacturer's or manufacturer's representative's facility. The training shall be as is typically provided for Contractor certification in maintenance of the systems and shall include any information requested by the Owner.

D. Training time is exclusive of travel time, breaks, lunch, etc.

1.26 TESTING AND CHECKOUT

A. After completion of any work installed under this section, field tests shall be performed and checkout of the system accomplished. The tests shall include functional and operational tests where applicable on all equipment under all conditions that exist at the time. All defects of new equipment disclosed by tests shall be rectified without additional cost to the Owner. The installing Sub-Contractor shall be required to make all adjustments to equipment and accessory material to provide a thoroughly functional installation. All new equipment shall be installed, tested and checked before the HVAC Sub-Contractor tests, adjusts or balances the system as a whole.

B. The TAB Sub-Contractor shall perform the services of testing, adjusting, and balancing of the heating, ventilating, and air conditioning systems. The TAB Sub-Contractor shall check and adjust all HVAC systems to produce the performance specified by the construction documents and to achieve total system balance. The Tab Sub-Contractor shall be certified by an appropriate air balance council, such as the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or other approved agency, or shall employ technicians certified by an appropriate air balance council, such as the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or other approved agency to perform the air balancing procedures. All work done by the TAB Sub-Contractor shall be by qualified technicians under the direct supervision of a certified test and balance engineer. The TAB Sub-Contractor shall furnish all certified engineers, instruments, and provide personnel, trained and experienced, to test, adjust and balance all airside systems and related automatic temperature control systems, and shall submit system performance reports.

C. The work to be performed by the TAB Sub-Contractor shall include, but not be limited to:

1. Adjustment of the airside performance of the HVAC systems to provide design air quantities and temperatures.
2. Electrical measurement.
3. The balance of all air and water distribution systems.
4. Verification of performance of all equipment, thermostats and controls.

D. The TAB Sub-Contractor shall accomplish these objectives by:

1. Checking installations for conformity to design.
2. Measurement and establishment of the air distribution quantities of the systems as required to meet the design specifications.
3. Adjusting and balancing all HVAC systems to meet the design specifications.
4. Recording and reporting all results in a format approved by the Architect.

E. All work shall be completed in accordance with the standards set by AABC, NEBB, or other approved testing and balancing organizations. In general, all equipment, materials, and balancing procedures shall comply with all applicable standards.

F. The qualifications of the TAB Sub-Contractor shall include current membership in AABC, or certification by NEBB, or the TAB Sub-Contractor shall submit proof to the satisfaction of the Architect that the TAB Sub-Contractor meets the certification requirements of the AABC or NEBB.

G. Submit for approval samples, shop drawings, certificates, literature and data with information sufficient to evaluate the submission in compliance with the requirements of a completely adjusted and balanced system. Testing, adjusting and balancing procedures shall equal those of approved submittals and shall not be completed or incorporated in the work until approved. Approval or acceptance of submittal items will not preclude rejection of these items upon discovery of defects in them prior to final acceptance of completed work.

H. All work shall be performed in compliance with the approved submittals. The work schedule shall include the proposed procedures, proposed forms, diagrams, and reports for documenting the work. The TAB Sub-Contractor shall establish an approved systematic and uniform set of procedures in compliance with the AABC or NEBB.

I. All test instruments shall be accurately calibrated and maintained in good working order. If requested, calibration tests of equipment to be used shall be performed in the presence of the Owner.

J. The equipment and systems shall be tested, adjusted and balanced in accordance with the approved submittals. Wherever the TAB Sub-Contractor deviates from the original procedures, he shall be responsible for the new procedures being a better method. Any changes made necessary by the above shall be brought to the attention of the Architect and shall be subject to his approval prior to making such change. The procedural changes shall not be made a basis for additional compensation by the Owner, but shall be made at the TAB Sub-Contractor's own expense.

1.27 DUCT CLEANLINESS

A. The Sheetmetal Sub-Contractor shall be responsible for the requirements of this section.

B. All ductwork shall be protected from dust and debris with plastic wrap on each end until installation. After installation, unfinished ends or grilles shall be covered until the system is in operation.

C. Any equipment connected to ductwork shall not be operated until construction progress has reached a point where minimal dust is being created as determined by the Architect.

D. If any equipment is to be used prior to the point of minimal dust creation, all return or exhaust intakes shall be covered with filter material and all filters in the equipment shall be changed on a daily basis.

1.28 IDENTIFICATION OF MECHANICAL SERVICES

A. Ductwork: Identify all ductwork with plastic adhesive labels identifying the system, supply, exhaust or return, and flow arrows.

B. Volume damper location flags

1. Flags: Yellow one-inch wide tape, minimum 18 inches long.

C. Piping: Identify all piping with plastic adhesive labels identifying the system, supply or return, and flow arrows.

1. Labels shall be located at all changes of direction, wall and floor penetrations, every 20 feet on long pipe runs, at valves and close to points of branch takeoffs.
2. Refrigerant piping shall identify fan coil unit served.

D. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Owner.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain

E. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.
2. Valve Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
3. Frame: Extruded aluminum.
4. Glazing: ASTM C 1036, Class 1, glazing quality B, 2.5 mm, single thickness glass.

F. Valve Schedule on Electronic Media:

1. In addition to the framed paper schedule, provide valve schedule on electronic media, type specified by Owner.
2. All valve tag locations shall be identified points on as-built drawings.

G. Equipment: Identify all energy recovery units, make up air units, controls, starters and similar equipment with white lamacoid engraved nameplates with black letters. Firmly secure with self-tapping screws.

1. Energy Recovery Unit identification shall be 6”x4” and shall indicate the following information:
   a. Tag number
   b. Design exhaust and supply airflow
   c. Design exhaust and supply external static pressure
   d. DX heating and cooling coil capacities
   e. Electric heat capacity
   f. Motor horsepower
   g. Power (volts/phase/hz)
2. Fan coil unit identification shall be 3”x2” and shall include the following information:

a. Tag number
b. Nominal cooling capacity (Btu/h)
c. Nominal heating capacity (Btu/h)
d. Rooms Served (ducted units only)
e. Power (volts/phase/hz)

3. Variable refrigerant volume heat pump system identification shall be 6”x4” and shall include the following information:
   a. Tag number
   b. Nominal cooling capacity (Btu/h)
   c. Nominal heating capacity (Btu/h)
   d. Power (volts/phase/hz)
4. Fan identification shall be 3”x2” and shall include the following information:
   a. Tag number.
   b. Design airflow (CFM)
   c. Design external static pressure (IN WC)
   d. Motor horsepower
   e. Power (volts/phase/hz)

1.29 DELIVERY, STORAGE AND HANDLING

A. No materials shall be delivered or stored on site until Shop Drawings have been approved.

B. All manufactured material shall be delivered to the site in original packages or containers bearing the manufacturer’s labels and product identification.

C. Protect materials against dampness. Store off floors, under cover, and adequately protected from damage.

D. Inspect all equipment and materials, upon receipt at the job site, for damage and conformance to approved shop drawings.

1.30 PROTECTION OF WORK AND PROPERTY

A. The HVAC Sub-Contractor shall be responsible for the care and protection of all work included under this section until the completion and final acceptance of this Contract.

B. Protect all equipment and materials from damage from all causes; including, but not limited to, fire, vandalism and theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment at no additional cost to the Owner.

C. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen under this section and make good damage thus caused.

D. Damaged materials are to be removed from the site; no site storage of damaged materials will be allowed.

1.31 SAFETY PRECAUTIONS

A. Life safety and accident prevention shall be a primary consideration. Comply with all of the safety requirements of the owner and OSHA throughout the entire construction period of the project.

1.32 SCHEDULE

A. Construct work in sequence under provisions of Division I and as coordinated with the Owner's Representative.

1.33 HAZARDOUS MATERIALS

A. Dispose of all hazardous materials in accordance with Federal and State laws. All handling shall conform to EPA requirements. A uniform hazardous waste manifest shall be prepared for all, disposals and returned with all applicable signoffs, prior to application for final payment. Provide breakout cost for this scope.

B. Recovered refrigerant shall be recycled by a licensed facility approved by the Owner's Representative.

C. Removed equipment or fluids containing any hazardous materials such as ethylene glycol, oil or chromate shall be recycled by a licensed facility approved by the Owner's Representative.

1.34 ACCESSIBILITY

A. All work provided under this section of the specification shall be installed so that parts requiring periodic inspection, maintenance and repair are readily accessible. Work of this trade shall not infringe upon clearances required by equipment of other trades, especially code required clearances to electrical gear. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made prior to written approval from the Owner's Representative.

1.35 ELECTRICAL WORK

A. All electrical apparatus and controls furnished, and the installation thereof, as a part of the HVAC work, equipment and controls shall conform to applicable requirements under specification 260000 – Electrical.

1.36 PROJECT CLOSEOUT

A. Certificates of Approval

1. Upon completion of all work, provide certificates of inspections from the following equipment manufacturers stating that the authorized factory representatives have inspected and tested the operation of their respective equipment and found the equipment to be in satisfactory operating condition and installed per the manufacturer's installation instructions and requirements.
   a. Automatic Temperature Controls
   b. Variable Refrigerant Volume Heat Pump System

B. Construction Observations by the Engineer

1. The engineer is contracted to make progress site visits during construction, one substantial completion (punch list) site visit for determining substantial completion and one Final inspection visit to determine if all work is complete.
2. The HVAC Sub-Contractor and the General Contractor are required to inspect their own work and make any corrections to the work to comply with the specifications and the contract documents. It is not the responsibility of the engineer to develop lists of incomplete work items.

3. Progress Site Visits
    a. The purpose of the progress site visit by the engineer is to observe if the work is proceeding in accordance with the contract documents.
    b. The engineer will prepare a field report which will note in general the work completed since the last observation visit, work found not to be in accordance with the contract documents and work not corrected since the previous observation visit.

C. Substantial Completion

1. When the HVAC Sub-Contractor considers the work under this Section is substantially complete, the HVAC Sub-Contractor shall submit written notice, through the General Contractor, with a detailed list of items remaining to be completed or corrected and a schedule of when each remaining work item will be completed. Should the engineer determine the list of remaining work does not constitute substantial completion, the engineer will notify the Architect and/or Owner and he will not make a substantial completion site visit.
2. The following items shall be submitted and approved by the Engineer prior to the written request for substantial completion inspection:
    a. Certification of successful operation of all systems
    b. Training of the Owner's personnel in the operation of the systems.
    c. Record Drawings in accordance with the contract specifications.
    d. Operation and Maintenance Manuals
    e. Testing reports
    f. Balancing reports
    g. Manufacturers certificates of approvals
    h. Emergency contact list for reporting of malfunctioning equipment during the warrantee period
    i. Contractors project completion certificate in accordance with the building code requirements.
3. Should the engineer, during the substantial completion visit, observe that the work is substantially complete, s/he will provide a written listing of the observed deficiencies referred herein as the Punch List. The Punch List will provide for a place for the HVAC Sub-Contractor and general contractor to sign off and date each item and individually indicating that the observed deficiency item has been corrected.
4. Should the Engineer, during the substantial completion site visit, observe that the work is not substantially complete, s/he will provide a written list of the major deficiencies and a reason for the work not being considered substantially complete.
5. If the work is found not to be substantially complete, then the engineer shall be reimbursed for his time to re-observe the work. A re-observation fee shall be charged to the Subcontractor through the Contractual Agreement for any further observations by the engineer.
6. The HVAC Sub-Contractor shall remedy all deficiencies listed in the punch list within the time frame required by the contract.

D. Engineers Construction Completion Certificate

1. Where required by the applicable code, the Engineers Construction Completion Certification will be issued by the Engineer when all life safety and health related issues are complete, all required functional tests are complete and all reports are complete.

The following is a minimum listing of the required systems to be tested with reports generated indicating they are complete and ready for use:

a. Air Balancing
b. Variable Refrigerant Volume Heat Pump System Start up
c. Pipe Pressure Test
d. Ductwork

2. There shall be NO outstanding items identified on the punch list for scope within any of these categories.

E. Final Completion

1. The following items shall be submitted prior to the written request for Final completion:
   a. Revised substantial completion items to be resubmitted in accordance with the review process comments
   b. Warranties commencing the date of substantial completion
   c. Individual signed and dated punch list acknowledging completion of all punch list items
2. When the HVAC Sub-Contractor considers all of the punch list work items complete, the HVAC Sub-Contractor shall submit written notice through the General Contractor that all punch list items are complete and resolved and the work is ready for final inspection. The signature lines for completion of each punch list item shall be signed by the HVAC Sub-Contractor indicating the work is complete and signed by the General contractor indicating site has inspected the work and found it to be complete. Should the Engineer find the work to be finally complete and all Punch list items are complete, the engineer will make a recommendation to the Architect or Owner. If the Engineer has found the punch list work to be incomplete during the final inspection, a written listing of the observed deficiencies will be prepared by the Engineer.
3. If the work is not fully complete then the engineer shall be reimbursed for his time to re-observe the work. A re-observation fee shall be charged to the HVAC Sub-Contractor through the contractual agreement for any re-observations by the engineer.

F. Re-Observation Fees

1. The re-observation fee shall be $1,800 per visit.

G. HVAC Sub-Contractor's Project Completion Certificate

1. Upon completion of work and prior to request for Certificate of Occupancy, the HVAC Sub-Contractor shall issue a certificate stating that work has been installed generally consistent with construction documents and all applicable codes. The certificate shall certify:
   a. Execution of all work has been installed in accordance with the approved construction documents.
   b. Execution and control of all methods of construction was in a safe and satisfactory manner in accordance with all applicable local, state and federal statutes and regulations.
2. The certificate shall include the following information:
   a. Project
   b. Permit Number
   c. Location
   d. Construction Documents

e. Date on Plans and Specifications submitted for approval and issuance of the Building Permit
f. Addendum(a) and Revision Dates

3. The certificate shall be signed by the HVAC Sub-Contractor and include the following:
   a. Signature
   b. Date
   c. Company
   d. License Number
   e. License Expiration Date

1.37 SEQUENCING

A. Phasing: Refer to Section 01 10 00 - Summary, and Drawings for phasing and milestone completion requirements which affect the Construction Manager's Work and the Work of the HVAC Sub-Contractor and related Sub-Contractors.

B. Coordinate work of this Filed Subcontract with that of other trades, affecting or affected by this work, and cooperate with the other trades as is necessary to assure the steady progress of work.

C. Do not order or deliver any materials until all submittals, required in the listed Specification Sections included as part of this Filed Subcontract, have been received and approved by the Architect.

D. Before proceeding with installation work, inspect all project conditions and all work of other trades to assure that all such conditions and work are suitable to satisfactorily receive the work of this Section and notify the Architect in writing of any which are not. Do not proceed further until corrective work has been completed or waived.

1.38 COMMISSIONING OF HVAC EQUIPMENT AND SYSTEMS

A. RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections.
2. An outside commissioning authority will commission the building at the completion of construction. Refer to SECTION 01 81 00 commissioning specifications for systems affected and contractor interface required.

B. SUMMARY

1. Section includes commissioning process requirements for HVAC&R systems, lighting control systems, and hot water heaters.
2. During Functional Testing, it is anticipated that the equipment will function as intended. Failure of an item includes excessive noise, failure to perform the intended function, or a deviation of more than 10 percent from the intended performance.
3. The CxA will choose specific pieces of equipment at random for testing.
4. A representative sample of large-volume equipment items of a similar nature (such as VAV terminals or heat pumps) may be chosen for testing. Failure of 10 percent (or 1, whichever is greater) of selected items shall result in stopping the Functional testing. The contractor shall remedy the deficiency and notify the CxA so that re-testing of failed portions can be performed.

5. Failure during retesting of any of the previously-failed items, or 10 percent (or 1, whichever is greater) of an additional sample roughly equal in size to the original sample, shall constitute failure, and shall necessitate testing of 100% of the installed equipment.
6. For small-volume or critical equipment (such as chillers or air handlers), every unit will be functionally tested.
7. At the CxA's sole discretion, many or all units of a similar nature (for example, heat pumps or fan coils) may be tested simultaneously in order to apply a thermal or electrical load on major contributing systems, such as chillers, boilers, cooling towers, or air handlers.
8. First-round testing is included in the CxA's budget. Any testing necessitated by above-described failures shall be at extra cost, and may be borne by the contractor.

C. DEFINITIONS

1. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
2. CxA: Commissioning Authority.
3. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
4. BMS: Building Management System, a computer-based system intended to monitor and control the operation of the HVAC equipment
5. TAB: Testing and Balancing
6. EOR: Engineer of Record
7. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

D. CONTRACTOR'S RESPONSIBILITIES

1. Allow sufficient time in the construction schedule, presented as a task in all project schedules, for on-site Functional Testing of equipment that is within the scope of work. CxA shall be consulted as early as possible to determine the appropriate amount of time necessary for testing. This time shall commence after all work is complete, TAB reports have been submitted, reviewed, and approved by the EOR, and equipment start-up sheets have been submitted and approved by the EOR. It will end prior to occupancy of the space. The time allotted for Commissioning SHALL NOT coincide with building flushing, balancing, or other testing or operations without the specific approval of the CxA.
2. Allow sufficient time in the schedule for repair of any faulty systems or components revealed during Functional Testing. One week is recommended.
3. Allow 5 working days minimum, prior to occupancy of the building, and after any repairs or reprogramming as per the previous item, for follow-up Functional Testing to prove that equipment and systems are operating and reporting properly
4. Perform all equipment inspections and testing prior to commissioning. Submit a complete manufacturer-recommended start-up checklist for all major equipment at least 2 weeks prior to commissioning.
5. Assure that the Testing and balancing work (TAB) work is complete, and that the TAB report is sent to the Engineer of Record for approval no later than 2 weeks prior to commissioning. A draft of the report is to be sent simultaneously to the CxA.

6. The Building Controls Contractor shall submit a complete controls submittal for review by the CxA, which shall include at a minimum operating sequences and sample graphics. This must be submitted with enough lead time to consider any recommendations by the CxA.
7. The Building Controls Contractor shall submit point-to-point checklists and calibration sheets at least two weeks prior to functional testing.
8. Submittals for any controls that are provided with equipment, such as proprietary boiler or air handler controls, must be provided to the CxA at least 2 weeks prior to functional testing
9. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
10. Provide information requested by the CxA for final commissioning documentation.
11. Provide a technician that is thoroughly familiar with the programming and operation of the BMS and other controls for assistance during functional testing.
12. Provide personnel as necessary to assist in the Functional Testing of the HVAC equipment.
13. Repair, reprogram, or otherwise correct any deficiencies that are revealed during functional testing, and report the corrections in the forma agreed to with the CxA and Project Management.
14. Assist as necessary in any retesting that is necessitated by failure of equipment or systems to perform as per the design intent.
15. Provide material for inclusion in the commissioning report. For example, as-built drawings, all testing, balancing, and start-up reports, water treatment reports, submittals for major equipment, and control system submittals.

E. CxA'S RESPONSIBILITIES

1. Include CxA responsibilities in this article that have an impact on Contractor's activities and responsibilities.
2. Provide Project-specific commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
3. Approved start-up reports, balancing reports, and control system point-to-point checklists and calibration reports shall serve as pre-functional testing. The CxA may choose to participate in this work.
4. Direct commissioning testing.
5. Verify testing, adjusting, and balancing of Work are complete.
6. The CxA shall judge whether equipment or systems function in a manner consistent with the design intent. A report shall be produced that lists any discrepancies.
7. Testing of any systems or equipment that fails the initial functional test will be repeated until all systems perform in accordance with the design intent and the intended operating sequences. Retesting may be additional to the contract value, and the cost may be passed through to the contractor responsible for the non-performing system.
8. A final commissioning report will be generated after all functional testing is complete. This report will contain as-built drawings, all testing, balancing, and start-up reports, water treatment reports, submittals for major equipment, and control system submittals.

F. COMMISSIONING DOCUMENTATION

1. Provide the following information to the CxA for inclusion in the commissioning plan:

a. Plan for delivery and review of submittals, systems manuals, and other documents and reports, including BMS, lighting control devices and systems, leak detection submittals.
b. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
c. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
d. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
e. TAB reports for both air and hydronic systems.
f. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
g. Test and inspection reports and certificates.
h. As-built drawings
i. Corrective action documents.
j. Verification of testing, adjusting, and balancing reports.
k. Maintenance requirements or recommendations for all equipment provided by the Contractor.
l. Recommended spare parts list
m. Contact names and phone number for warranty or maintenance during the warranty period, as well as a 24-hour emergency contact.

G. SUBMITTALS

1. Paragraphs below are "Informational Submittals." See Division 01 Section "Submittal Procedures" for definition of "Informational Submittals."
2. Certificates of completion of installation, prestart, and startup activities.
3. Control system submittals
4. Point-to-point checklists and instrument calibration records.
5. TAB Report
6. Start-up/checkout checklists and reports
7. As-built drawings

2 PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials, except as otherwise specified, shall be new, of current production, first quality and the best of each class specified.

B. Required materials not covered by detailed specifications shall be of a suitable class, grade, quality and type and shall be subject to the approval of the Architect. Where two or more units of the same class of equipment are required, these units shall be the products of a single manufacturer.

C. All equipment shall be installed and constructed to operate safely, as designed, without leakage, undue wear, noise, vibration or corrosion.

2.2 ELECTRIC MOTORS AND RELAYS

A. Design, type and ratings of electric motors shall comply with the National Electrical Code, NEMA and Underwriter's Laboratory.

B. Unless otherwise noted or required for special applications, motors shall be open drip- proof with sealed ball bearings.

C. All electric motors shall be of the voltage, type and frame as specified in the electrical portion of the specifications.

2.3 ACROSS-THE-LINE STARTERS

A. All motor starters shall be across-the-line start with magnetic contactors and thermal overloads properly sized for the motor nameplate data.

B. All motor starters shall be furnished with a Hand-Off-Auto (HOA) switch mounted on the cover of the enclosure.

C. All motor starters shall be furnished with a fused 120 volt control power transformer rated at a minimum of 2 amps.

D. All motor starters shall be furnished mounted in a NEMA 1 enclosure suitable for the mounting location.

E. All motor starters shall be provided with magnetic contactors having one normally open and one normally closed auxiliary contactor.

2.4 HANGERS AND SUPPORTS

A. Pipe hanger or stanchion support assemblies shall include turnbuckles or other means of vertical adjustment.

B. Trapeze hangers may be used in lieu of separate hangers for closely spaced, parallel lines. Pipe hanger components shall be as per MSS SP-58.

C. Hangers shall have steel rods with two nuts and shall be suspended from suitable beam clamps or concrete inserts. Rod sizes shall be as recommended by the hanger manufacturer and at least the following:

Pipe to 2" ..... 3/8" diameter
2½" - 3"..... 1/2" diameter
4- 5" ..... 5/8" diameter

D. Maximum hanger or stanchion support spacing for copper or steel pipe shall be as follows:

PIPE SIZE	MAX SPACING	PIPE SIZE	MAX SPACING	PIPE SIZE	MAX SPACING
3/4” or less	5 feet	2 ½"	9 feet	6"	14 feet
1”	6 feet	3"	10 feet	8"	16 feet
1¼"	7 feet	3 ½"	11 feet	10"	18 feet
1½"	8 feet	4"	12 feet	12"	19 feet
2”	8 feet	5"	13 feet	14"	25 feet

E. Hangers or stanchion supports for copper tubing shall be copper plated where they contact the copper tubing.

F. Hangers or stanchion supports for insulated pipe shall have insulation shields.

G. All rigid piping attached to the building and serving equipment subject to vibration shall be hung or supported on vibration isolators for the first 20 feet.

H. Vertical rises shall be supported from stands at the bottom of the rise or hangers at the top of the rise as shown on the drawings per the HVAC Sub-Contractor's option.

I. All hangers on insulated piping to be sized to fit around the insulation.

2.5 ANCHORS

A. Anchor points as shown on the drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.

2.6 VIBRATION ISOLATORS

A. Double deflection neoprene mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be provided for these areas where bolting is required.

B. Spring type isolators shall be free standing and laterally stable without any housing and complete with ½" neoprene acoustical friction pads between the baseboard and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 80% of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height.

C. Vibration hangers for piping and mechanical equipment shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bussing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through an arc of 30° before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing showing the 30° swing capability. For locations requiring precise elevation during installation the hanger shall be precompressed to the rated deflection and the released after completion of the installation.

D. Vibration hangers for duct systems shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through an arc of 30° before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing showing the 30° swing capability.

E. Horizontal thrust restraints shall be provided on equipment subject to excessive displacement. The horizontal thrust restraint shall consist of a spring element in series with a neoprene pad. The spring element shall be contained within a steel frame and designed so that it can be preset for thrust and adjusted to allow for a maximum of ¼"

movement when the equipment starts or stops. The assembly shall be furnished with one rod and angle brackets for attachment to the equipment and the ductwork. Horizontal thrust restraints shall be attached at the centerline of the thrust and symmetrically on each side of the unit.

2.7 CONDENSATE PIPING

A. Condensate piping shall be type-L copper with soldered joints. All 90° changes in direction shall be made with 45° elbows and tee-wyes with cleanouts, not with straight tees.

B. Solder shall be 95/5 non-lead solder.

2.8 REFRIGERANT PIPING

A. All refrigeration system piping shall be as follows:

Construction	Hard brazed joints
Piping	Copper tubing type ACR, hard drawn, cleaned, dehydrated and capped for refrigeration service, ANSI B70.1 ASTM A-280
Fittings	Wrought copper, Brazed joint type, ANSI B16.22
Coupling	Same as above
Brazing Alloy	Easy Flo, Silfos, Phos Co., Minimum 1100 °F melting temperature, ASTM 280

B. Soft drawn copper tubing may be used in sizes acceptable to the refrigeration equipment manufacturer.

2.9 PIPING INSULATION MATERIALS

A. Insulation for pipe shall be glass fiber with a K factor of .24 at 100° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket with a factory applied double pressure sensitive adhesive sealing system.

B. Insulation for concealed fittings and valves shall be glass fiber blanket with a K factor of .24 at 75° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket.

C. Exposed fittings, valves and flanges shall be insulated with molded fitting covers or fabricated segments of pipe insulation.

D. Insulation, jacket, covers and sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per UL 723.

E. Insulation shall be Owens-Corning Fiberglass ASJ/SSL-II or approved equal.

F. All refrigerant piping (suction and liquid lines) shall be insulated with flexible foamed plastic, minimum 5.0 lb. per cubic foot density, thermal conductivity not greater than 0.27 Btu-in/sq. ft/°F/hour at mean temperature difference of 75°F.

G. Multiple layers of refrigerant piping insulation shall be provided to achieve the overall required thickness.

H. All outdoor exposed refrigerant piping shall be encased in Zeston PVC Jacketing as manufactured by Johns Mansville or pre-approved equal. All seams shall be located on

the lower half of the pipe. Fittings shall be covered using PVC fitting supplied by the manufacturer.

1. All refrigerant support and mounting clips shall be installed on the outside of the insulation and/or jacketing.

I. Insulation thickness shall be as follows:

SYSTEM	PIPE SIZE	THICKNESS or R-value
Refrigerant Piping (suction and liquid)	7/8" and smaller 1" and up	½" 1"
Condensate Drain Piping	1¼" and smaller 1½" and up	½" 1"

2.10 PVC INSULATION JACKET

A. High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; 25/50 flame-spread/smoke developed rating; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Johns Manville; Zeston.
2. P.I.C. Plastics, Inc.; FG Series.
3. Proto Corporation; LoSmoke.

C. Adhesive: As recommended by jacket material manufacturer.

1. Color: White.

D. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

E. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville: Z-Tape
   b. ABI, Ideal Tape Division; 370 White PVC tape.
   c. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

F. The following piping shall be jacketed:

1. All refrigerant piping located outdoors.

2.11 VALVES

A. All valves shall be first quality of an approved manufacturer, shall be installed with the proper clearances and shall be tight at the specified pressures.

B. Valves shall be of minimum working pressure and materials as fittings specified for the service, however, in no case shall valves be designed for less than 125 PSI working pressure.

C. Where a specific manufacturer, brand and/or figure number is specified, an equivalent figure from an approved manufacturer shall be acceptable.

D. For shut off service the HVAC Sub-Contractor shall use ball valves with full open ID.

E. For throttling or modulating service the HVAC Sub-Contractor shall use a butterfly valve or another type of valve if a specific valve is specified on the drawings.

F. Check Valves

1. Check valves shall be bronze 2." and smaller; Cast iron or cast steel with bronze trim for 3" and larger.
2. All check valves shall have removable caps and regrindable disc and seat ring.
3. Bronze check valves shall be rated 125 PSI SWP, 200 PSI WOG as NIBCO figure T-413 or S-413.
4. Iron Check valves shall be 125 PSI SWP, 200 PSI WOG as NIBCO figure F-918.

G. Ball Valves.

1. Ball valves shall be bronze 2½" and smaller equal to Apollo Ball Valves 70 series.
2. Ball valves shall be rated for 200 PSI @ 250°F.

2.12 PIPE LABELS

A. All refrigerant piping shall be labeled with plastic adhesive labels. Labels shall indicate the piping system (refrigerant suction, refrigerant liquid, etc.), and shall indicate the direction of flow. Piping shall be labeled every 20 feet minimum on straight runs, within 2 feet of access panels and shall be labeled within five feet of changes of direction. Labels shall be applied to the insulation jacket.

1. All refrigerant branch circuits shall be labelled with the fan coil tag number served.

2.13 SLEEVES

A. Provide Schedule 40 galvanized steel pipe sleeves for each pipe passing through a wall, floor, partition or roof.

2.14 FIRE-STOPPING

A. Seal annular spaces between sleeves and penetrating materials in fire-rated floors, ceilings, and walls with fireproof and waterproof silicone elastomer applied in accordance with the manufacturers published instructions. Multiple penetrations shall be sealed with silicone foam; single penetrations may be sealed with silicone caulking. Seal material shall be UL classified for use in fire-rated penetration seals, and shall be applied in the manufacturer's recommended thickness for the fire rating of the penetrated structure in accordance with ASTM-E-814 requirements.

B. Acceptable Manufacturers: Dow Corning, General Electric, 3M.

2.15 WATERPROOFING

A. Seal penetrations of wet or potentially wet structures, floors, exterior walls, etc., other than those requiring fire stopping, with sealant to prevent moisture leakage. Apply sealing material (caulking) in accordance with manufacturer's published instructions.

B. Product Research and Chemical Co. "Poly-Sulphide Sealant" PRC-5000.

2.16 FILTERS

A. Refer to equipment schedules and specifications for filter requirements.

B. Unless otherwise noted panel filters shall be 1" MERV 8 filters.

C. Provide one (1) set of spare filters for each piece of equipment.

2.17 RECTANGULAR DUCTS

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

B. Duct sizes shown on the drawings are the clear inside dimensions, after any lining has been applied.

C. Ductwork for ERV-1, RTU-1 & 2, exhaust fan and fan coils shall be constructed to 2" static pressure class requirements.

2.18 RECTANGULAR DUCT FITTINGS

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

2.19 ROUND DUCTS

A. All round ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

B. All round spiral duct and fittings shall be manufactured from G-90 galvanized steel, conforming to ASTM and SMACNA standards. Standard elbows will have 1.5 centerline radius. Other radii and vaned elbows are available as needed. Elbows through 12" shall be die formed, with stitch welded joints. Elbows 14" through 30" shall be gore-locked construction. All elbows above 32" shall also be gored, but with tack weld and sealed construction for use to 4" w.g., or solid welded for use to 10" w.g.

2.20 FLEXIBLE DUCTS

A. All flexible ducts shall be constructed of a trilaminate of aluminum foil, fiberglass and aluminized polyester mechanically locked to a galvanized steel helix. No adhesives shall be used to lock the fabric to the helix.

B. All flexible ducts must conform to NFPA 90A and 90B requirements and be tested in accordance with UL-181 and bear a UL label and be installed in accordance with their

listing by UL. Flexible ducts shall have a flame spread rating or 25 or less and a smoke developed rating or 50 or less per UL 723.

C. Insulated flexible duct shall have a block fire retardant polyethylene outer jacket with a ½ lb. density 1-1/2" thick fiberglass insulation jacket.

D. Flexible ducts 12" diameter and smaller shall be rated at 12" positive pressure and 10" negative pressure. Flexible ducts 14" and 16" diameter shall be rated at 5" positive and negative pressure and flexible ducts 18" diameter and larger shall be rated at 1" positive and negative pressure.

E. Flexible ducts shall not exceed 5 feet in length.

2.21 FLEXIBLE CONNECTORS

A. All connections between vibrating or rotating equipment and ductwork shall be made with a flexible connection consisting of a heavy fiberglass fabric, double coated with neoprene and shall be fireproof conforming to NFPA 90A, waterproof and airtight. The flexible connection shall be a minimum of 6" long and held in place with heavy metal bands.

2.22 DUCT INSULATION MATERIALS - DUCT WRAP

A. Insulation for ducts and fittings shall be glass fiber with a K factor of .25 at 75° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket with a 2" stapling flange.

B. Insulation, jacket and sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per UL 723.

C. Insulation for concealed ductwork shall be Owens-Corning Fiberglass Type 150 or approved equal.

D. Exposed exterior ductwork insulation shall be protected with a waterproof EPDM membrane with all seams sealed water tight and all longitudinal seams located on the bottom of the duct.

E. The following ducts shall be insulated:

1. All exterior ERV-200 system supply and return ducts.

2.23 SPIRAL DUCT LINING

A. Basis of design is Johns Manville Spiracoustic Plus fiberglass spiral duct liner. Alternate manufacturers are Owens Corning and CertainTeed.

B. Materials: All supply ducts, return ducts, and fittings insulated with Spiracoustic Plus System round duct liners, meeting the following requirements:

1. Minimum thermal conductance of 0.23 at 75°F based on 1" material thickness.
2. Noise reduction coefficient of 0.75 for 1" board, 0.85 for 1.5" board, and 0.95 for 2" board when tested in accordance with ASTM C423 when using a type "A" mounting.
3. Maximum rated velocity of 6000 FPM when tested in accordance with UL 181.
4. Fiber shed shall not be detectable as determined by electron microscopy analysis of isokinetic sampling at maximum rated velocity.

5. Duct liner shall have a FHC rating of 25/50 and be classified as meeting the requirements of limited combustibility.
6. The air stream surface shall have a 100% coverage coating of acrylic polymer formulated with an immobilized EPA registered anti-microbial agent proven resistant to microbial growth as determined by ASTM G21.
7. Material shall be certified by GreenGuard.
8. Shall not contain asbestos, lead, mercury, or mercury compounds.

C. Accessories

1. Joint closure tape meeting the requirements of UL 181A, as identified by imprinting on the tape foil surface.
2. SuperSeal® coating products for coating exposed edges, connections or minor surface damage not requiring replacement of insulation.
3. Duct liner adhesive, when required, meeting the requirements of ASTM C9l6.
4. Duct liner pins, when required, meeting the requirements of Johns Manville Spiracoustic Plus Installation Guide, Sections 5 and 6.

D. The following ducts shall be lined:

1. All exposed supply and return ductwork in the Gymnasium shall be lined with 1” in its entirety.

E. Duct dimensions shown on the drawings are the clear inside dimensions, after the lining has been applied.

2.24 ACOUSTICAL DUCT LINING

A. Acoustical duct lining shall be constructed of a semi-rigid board of glass fiber with a black-pigmented, fire resistant coating on the side toward the airstream. The duct lining shall comply with the requirements of NFPA 90 and ASTM C 1071.

B. Duct lining shall have a thermal conductivity of 0.25 Btu*in/hr*ft^2*ºF.

C. The following ducts shall be lined:

1. All ERV supply and return/exhaust duct connections to the unit shall have 1” lining for the first 10 feet or past the second elbow, whichever is further.

D. Duct dimensions shown on the drawings are the clear inside dimensions, after the lining has been applied.

2.25 VOLUME DAMPERS

A. Furnish and install, where indicated on the drawings or where required for balancing, air splitter dampers, butterfly dampers, or opposed blade dampers with indicating and locking quadrants or push rods and pillow blocks.

B. Opposed blade dampers shall be manually operated multi-blade type with sleeve bearings, galvanized steel interlocking blades and a galvanized steel frame. In ducts over 19" in depth and 12" in height, use multiple opposed blade type, gang operated dampers with a maximum blade width of 8". Fabricate the damper blades of 10-gauge steel with hemmed edges, and a maximum length of 48". Damper operating rods shall be the full blade length and shall extend through the duct to externally mounted bearing plates. On insulated ductwork, bearing plates shall be flush with insulation finish and fastened to the duct. The operating lever shall be of the indicating type with

locking quadrant. Splitter dampers shall be sufficiently long to extend the full width of the branch duct to which they are attached. Where necessary they shall curve to scoop branch duct air out of the main duct air stream. The dampers shall be constructed in accordance with the latest SMACNA standards and shall be at least two gauges heavier than the ducts in which they are installed.

2.26 CONTROL DAMPERS & ACTUATORS

A. Control dampers based on Greenheck series VCD-34 low leakage insulated blade or approved equal.

B. General:

1. Blade action shall be opposed.
2. Dampers shall meet or exceed the IECC (International Energy Conservation Code) requirements for damper leakage ratings of 3 cfm/ sq. ft @ 1 in. wg or 8 cfm/sq. ft. @ 4in. wg or less when integral to the building envelope.
3. The Damper Manufacturer's submittal data shall certify that all pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3, and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal. AMCA certified pressure drop for a 24 in. wide x 24 in. high damper shall not exceed 0.04 in. wg when subjected to an airflow velocity of 1500 fpm according to AMCA Test Figure 5.3.
4. Dampers shall bear the AMCA Certified Ratings Seal for Air Performance in accordance with AMCA 511 (VCD-20, VCD-23, VCD-33, VCD-34, SEVCD-23 and SEVCD-33).
5. Dampers shall bear the AMCA Certified Ratings Seal for Air Performance Air Leakage in accordance with AMCA 511 (VCD-23, VCD-33, VCD-34, SEVCD-23 and SEVCD-33).

C. Construction:

1. Damper frame shall be 16 ga. galvanized steel formed into a 5” x 1” structural hat channel. Top and bottom frame members on dampers less than 17” high shall be low profile design to maximize the free area of these smaller dampers. Frame shall be 4-piece construction with 1 ½” (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking. Stainless steel frame is optional.
2. Damper blades shall be airfoil shape, galvanized steel double skin construction (14 ga. equivalence) filled with ½ in. polystyrene on each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening. Blade orientation is horizontal. Stainless steel blade is optional.
3. Linkage shall be plated steel.
4. Axles shall be plated steel.
5. Axle bearings shall be synthetic (acetal) sleeve rotating in polished extruded holes in the damper frame.
6. Mill galvanized finish is standard.

D. Actuator

1. Electric, 24V DC, 2-position
2. External (outside of duct)

2.27 DRIP PANS

A. Examine the drawings and in cooperation with the Electrical Contractor confirm the final location of all electrical equipment to be installed in the vicinity of piping. Plan and arrange all overhead piping no closer than two feet from a vertical line to electric motors and controllers, switchboards, or similar equipment. Piping is not permitted in electric equipment, transformer, switch gear and telephone gear rooms.

B. Where the installation of piping does not comply with the requirements of foregoing paragraph, where feasible the piping shall be relocated.

C. Where relocation of piping is not feasible, furnish gutters as follows:

1. Provide and erect a gutter of 16 ounce cold rolled copper or 18 gauge galvanized steel, under every pipe which is within 2 feet from a vertical line to any motor, electrical controllers, switchboards, panelboards or the like.
2. Each gutter shall be reinforced, rimmed, soldered and made watertight, properly suspended and pitched to a point outside of the electrical room.

2.28 ACCESS PANELS

A. Hinged access panels shall be provided at locations of volume dampers, control dampers, and elsewhere as required to service the duct systems. Access doors shall be fully gasketed for airtight seal at the rated working pressures of the systems in which they are installed. Access doors shall be adequately sized for their intended purpose and equipped with a minimum of two sash locks. Access doors in insulated ducts shall be double wall and insulated.

B. Access panels shall be provided at locations of the variable refrigerant volume systems if located above hard ceilings.

C. Coordinate with requirements of Specifications Section 083110.

2.29 REGISTERS, GRILLES AND DIFFUSERS

A. The types, sizes and airflow patterns of the registers, grilles and diffusers as specified and as shown on the plans have been selected to accomplish the intent and purpose of the system. Any substitutions proposed for items scheduled, shown or specified must provide the same air flow patterns, at the same air volumes and must have the same acoustical characteristics as the specified elements.

B. All interiors of all ducts in back of all registers, grilles and diffusers shall be painted with one coat of flat black nonflammable paint.

C. Duct connections to supply devices shall be made inside the collars, if any, and, duct connections to return or exhaust devices shall be made outside the collars, if any.

D. All registers, grilles and diffusers shall have a baked enamel, white, semi-gloss finish.

E. Square and rectangular diffusers shall have removable cores with opposed blade dampers, gasketed borders and concealed fastenings.

F. Frame types of diffusers shall be as appropriate for the type of ceiling in which they are to be installed.

G. Supply, return and exhaust air registers shall have opposed blade dampers and gasketed borders.

2.30 CONSTANT AIRFLOW REGULATOR

A. Constant airflow regulators basis of design is American Aldes.

B. Refer to plans and schedules for models, accessories and quantities.

C. Model CAR3 Constant Airflow Regulator

1. Airflow regulator shall be capable of maintaining constant airflow within +/-10% of the scheduled flow rates, within the operating range of 0.12 to 1.2 in. w.g. differential pressure for low-pressure models (CAR3-L), or 0.4 to 2.8 in. w.g. with high-pressure models (CAR3-H).
2. CAR3 solely operate on duct pressure and require no external power supply or sensors, and shall be rated for use in air temperatures ranging from -25°F to 140°F (-32°C to 60°C).
3. CAR3 must be equipped with double lip gasket to provide a secure, leak free installation into rigid round duct, take-offs, collars, etc.
4. Each regulator shall feature dual-side adjustment dial to allow changes in airflow setpoint while installed in either the supply or exhaust direction without removing the regulator from the duct.
5. Each CAR3 must be calibrated to match the airflows indicated on the schedule or drawings.
6. Regulator must be classified per UL 2043 and carry the UL mark indicating compliance.
7. Constant Airflow Regulator shall be enhanced with antimicrobial, anti-static, and flame retardant additives for increased durability and safety, and covered under warranty for a period of no less than seven years.
8. Constant Airflow Regulator shall be installed in accordance with local code and manufacturer’s instructions.

D. Model ZRT-PDIL Parallel Damper In-Line Zone Terminals

1. The terminal casing shall be minimum 24-gauge G90 galvanized steel with duct flange that allows attachment of rectangular rigid ducting in a slip-type duct connection.
2. Each terminal shall include integral, pressure-independent Constant Airflow Regulators (CAR) that provide the capability of automatically regulating airflow in both a continuous and boost setting. Each regulator shall automatically respond to changes in duct pressure to maintain specified flow rates at a constant level.
3. The low-volume continuous and on-demand boost Constant Airflow Regulators (CAR) shall be factory calibrated to the specified set points. Both regulators shall be capable of being adjusted in the field to any desired airflow within their noted minimum and maximum setpoints.
4. The continuous CAR will automatically control the amount of air any time the central fan is operating.

5. The boost CAR shall be located in series with a motorized single-blade damper operated by a long-life synchronous-drive motor with normally closed spring-return closure. When the ZRT-PDIL is powered, the motorized damper will open allowing air through the boost regulator, automatically adding the prescribed boost rate to the continuous rate during central fan operation. The damper blade shall rotate on a solid one-piece damper that pivots on permanently lubricated bearings. A permanently fixed perimeter gasket seal shall be provided to prevent air noise and leakage at the closed position.
6. The entire damper assembly and all operable parts shall be capable of being removed from the terminal housing from below without disconnecting duct or removing the housing. Access to all regulator and damper components shall be through an integral screw-on access plate.
7. All terminals and/or pertinent components must be listed per UL standards and carry the UL, UR or ETL mark indicating compliance.
8. Each ZRT-PDIL shall include all necessary mounting brackets and hardware.
9. Installation shall be per all applicable codes and manufacturer's instructions.

2.31 CEILING MOUNTED EXHAUST FANS

A. General:

1. Base fan performance at standard conditions (density 0.075 Lb/ft3)
2. Ceiling mounted applications
3. Maximum operating temperature is 130 Fahrenheit (54.4 Celsius)
4. Sound levels as low as 0.7 AMCA sones
5. UL/cUL listed for above bathtub exhaust
6. Fans are UL/cUL listed 507 - Electric Fans
7. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number
8. Fans shall be manufactured by Greenheck (basis of design) or approved equal.

B. Wheel:

1. Forward curved centrifugal wheel
2. Constructed of galvanized steel or calcium carbonate filled polypropylene
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05

C. Motors:

1. AC Induction Motor
    a. Motor enclosures: Totally enclosed air over: (TEAO)- designed to be used solely in the airstream, constructed with a dust tight cover and an aerodynamic body which relies upon the strong airflow of the fan to cool the motor, not suitable for hazardous environments.
    b. Motors shall be permanently lubricated sleeve bearing type to match with the fan load and furnished at the specific voltage and phase.
    c. Motor shall be mounted on vibration isolators and be accessible for maintenance
    d. Thermal overload Protection

D. Housing:

1. Constructed of heavy gauge galvanized steel
2. Interior shall be lined with 0.5 inches of acoustical insulation
3. Profile as low as 10 1/2 inches

E. Spring Loaded Aluminum Backdraft Damper:

1. Prevents air from entering back into the building when fan is off
2. Eliminates rattling or unwanted backdrafts

F. Outlet:

1. Type of outlet: Round
2. Field rotatable from horizontal to vertical discharge
3. Shall include an aluminum backdraft damper

G. Mounting Brackets:

1. Fully adjustable for multiple installation conditions

H. Options/Accessories:

1. Thermostat:
   a. Type: Cooling
   b. Control the fan based on temperature of the space
   c. Contacts close on temperature change
2. Transformer:
   a. Type: T-2.0 - UL listed, Rated for 230/277v to 115, 2.0 amps max at 120 volts
   b. Available for applications requiring voltage reduction
   c. All transformers are shipped loose
3. Vibration Isolation:
   a. Available for suspended installations
   b. Includes pre-punched hole for ease of installation and shall have all hardware to mount one unit

2.32 DESTRATIFICATION FANS

A. Destratification fans basis of design is Airius, ONYX series.

B. General

1. Performance: Coordinated design of housing, stator and motor shall provide columnar laminar airflow to produce a minimum of 100 fpm at center of column at grade level when installed within 2’-0” of ceiling. Refer to manufacturer’s airflow velocity profiles for jet pattern and throw data.
2. Housing: The fan housing shall be made of PC/ABS resin, rated 5VA for flame resistance.
3. Housing color:
   a. PMS Cool Gray 2C (off white)
   b. Black
   c. As scheduled

4. Safety Cable: Supplied with 6’-0” steel cable fastened to seismic restraint point integrated into the fan housing. Safety restraint attached to primary mounting handle will not be accepted.
5. Motor Mounting: Enclosed in housing, above stator.
6. Stator: The fan shall be equipped with a patented curved multiple-vane stator coordinated with fan design for maximizing columnar laminar flow.
7. Bypass Technology: The fan shall be equipped with multiple bypass vents within the outer housing to maximize air entrainment through the housing to maximize volume output.
8. Certification: UL Standard 507 for Safety Electric Fans, CAN//CSA-C22.2 No. 1113 and UL 94 5VA as certified by nationally recognized testing laboratory. Acceptable laboratories include ETL, UL or other nationally recognized testing laboratories.
9. Identification: Permanently affixed manufacturer’s nameplate including the following: Model Number, Serial Number, Motor Power Specifications, Country of Manufacture and Safety Marks: ETL (US & CA) & CE (EU).
10. Power Cord: 6 foot, 300-volt AC, UL rated. Motors within the range of 100-130VAC are provided with a standard 3-prong plug. Motors within the range of 200-277VAC are not provided with a plug.
11. Motor:
    a. Electrically commutated motor, up to 92% efficient. Plastic blades bolted to steel hub. Ball bearings shall be permanently lubricated and shielded. Up to 1422 cfm, 1732 rpm,. Thermally protected motor with an operating range of -40° F (-40° C) to +176° F (80° C).
    b. Recommended ceiling height up to 50 feet (15.2 m) and area coverage up to 2000 sq. ft (185.8 sq. m); 25 feet (7.6 m) from the fan's center in all directions.
12. Electrical Requirements:
    a. 100-130V AC, single phase, 50/60 Hz.; 1.32 Amps; 90 watts
    b. 200-240V AC, single phase, 50/60 Hz.; 0.8 Amps; 98 watts
13. Controls shall be coordinated with motor electrical requirements.
    a. Shall be controlled directly by 0-10VDC control signal from BAS. Uses low voltage control circuit separate from mains power. See wiring diagram.
    b. Provide with BACnet MS/TP card for individual fan control and status integration with BAS.

2.33 DIRECT DRIVE INLINE FANS

A. Inline fans basis of design is Greenheck.

B. General

1. Base fan performance at standard conditions (density 0.075 Lb/ft3)
2. Performance capabilities up to 27,800 cubic feet per minute (cfm) and static pressure to 3.0 inches of water gauge
3. Fans are available in twenty-four sizes with nominal wheel diameters ranging from 7 inches through 33 inches
4. Continuous operating temperature range of -10º Fahrenheit (-23.3º Celsius) to 130º Fahrenheit (54.4º Celsius)

5. Applications include: supply, exhaust, return, or make-up air systems
6. UL-705 certified for indoor (standard) and outdoor applications (must configure fan for outdoor use to allow outdoor installation)
7. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number

C. Wheel:

1. Non-overloading, backward inclined centrifugal wheel
2. Constructed of Aluminum
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency
5. Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone

D. Motors:

1. Electronically Commutated Motor
2. Motor enclosure: Open drip proof
3. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors
4. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase
5. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor
6. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal
7. Motor shall be a minimum of 85% efficient at all speeds

E. Housing/Cabinet Construction:

1. Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars
2. Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.
3. Galvanized Construction material

F. Housing Supports and Drive Frame:

1. Housing supports are constructed of structural steel with formed flanges
2. Drive frame is welded steel which supports the motor

G. Disconnect Switches:

1. NEMA rated: NEMA 1: indoor application no water. Factory standard.
2. Positive electrical shut-off
3. Wired from fan motor to junction box

H. Duct Collars:

1. Square design to provide a large discharge area
2. Inlet and discharge collars provide easy duct connection

I. Access Panel:

1. Two sided access panels, permit easy access to all internal components
2. Located perpendicular to the motor mounting panel

J. Options/Accessories:

1. Dampers:
    a. Type: BD-330, Gravity
    b. Galvanized frames with prepunched mounting holes
    c. Balanced for minimal resistance to flow
2. Insulated Housing:
    a. 1 inch thick insulated housing
    b. For noise reduction and condensation control
    c. Constructed of fiberglass liner
3. Motor Cover:
    a. Constructed of galvanized steel
    b. Covers motor and drives for safety
    c. Standard on unit specified with UL

2.34 VARIABLE REFRIGERANT VOLUME HEAT PUMP SYSTEM

A. General

1. Per the equipment schedule, the variable capacity, heat pump heat recovery air conditioning system basis of design is Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system(s).
2. Acceptable alternative manufacturers, assuming compliance with these equipment specifications, are Trane, Panasonic, and Hitachi. Contractor bidding an alternate manufacturer does so with full knowledge that that manufactures product may not be acceptable or approved and that contractor is responsible for all specified items and intents of this document without further compensation.
3. Simultaneous heating/cooling (heat recovery) systems shall consist of an outdoor unit, BC (Branch Circuit) Controller (or comparable branch devices), multiple indoor units, and an integral DDC (Direct Digital Controls) system. Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. To ensure owner comfort, each indoor unit or group of indoor units shall be independently controlled and capable of changing mode automatically when zone temperature strays 1.8 degrees F from set point for ten minutes.
4. No additional branch circuit controllers (or comparable branch devices) than shown on the drawings/schedule may be connected to any one outdoor unit. Contractors proposing alternate systems requiring more branch devices than those included as the basis of design are responsible for additional piping & electrical costs and are required to identify additional costs & installation time required of other trades with their bid.

5. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.
6. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
7. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
8. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.
9. System start-up supervision shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in system configuration and operation. The representative shall provide proof of manufacturer certification indicating successful completion within no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals.

B. System Start-Up

1. The manufacturer or manufacturer's representative shall provide start-up services for the system and shall provide a report on the start-up procedure and provide documentation that the system is installed and functioning per the manufacturer's specifications.
2. The manufacturer or manufacturer's representative shall provide integration system assistance as required to assist the ATC sub-contractor in integrating the VRV system with the DDC system.

C. System Training

1. The manufacturer or manufacturer's representative shall provide training for the Owner or Owner's representative. Training shall be a minimum of 4 hours and shall be conducted at the same time as the training for the other HVAC systems.
2. The manufacturer shall also provide 16 hours of structured off-site training for the Owner's personnel.

D. Warranty

1. The CITY MULTI units shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and seven (7) year compressor to the original owner from date of installation.
2. Installing contractor shall meet manufacturer requirements to obtain extended manufacturer's limited parts and compressor warranty for a period of ten (10) years to the original owner from date of installation. This warranty shall not include labor.
3. All manufacturer's requirements to obtain the limited warranty shall be met, including but not limited to: designed by a certified City Multi Diamond Designer, installation by a contractor that has completed the Mitsubishi service course, and submission of a completed commissioning report that is approved by Mitsubishi.
4. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.

5. The CITY MULTI VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

E. System Efficiency

1. The systems shall have the following minimum efficiencies in order to comply with the Eversource Path 1 Net Zero Equivalent (NZE) rebate program for new buildings program requirements.
2. Units shall be ASHRAE 90.1 rated in accordance with AHRI 1230.
3. Minimum efficiencies for Units =>135,000<240,000 BTUH:
    a. EER – 10.6
    b. IEER – 11.8
    c. COP - 3.2
4. Minimum efficiencies for Units =>240,000 BTUH:
    a. EER – 9.5
    b. IEER – 10.6
    c. COP – 3.2

F. High Efficiency Y-Series Air Cooled Heat Pump

1. General
    a. The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section and Controls section. The outdoor unit modules shall be equipped with a single compressor which is inverter-driven and multiple circuit boards—all of which must be manufactured by the branded VRF manufacturer. Each outdoor unit module shall be completely factory assembled, piped, and wired and run tested at the factory.
    b. Outdoor unit systems may be comprised of multiple modules with differing capacity if a brand other than basis of design is proposed. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.
    c. Outdoor unit shall have a sound rating no higher than 68 dB(A) individually or 70 dB(A) twinned. Units shall have a sound rating no higher than 52 dB(A) individually or 55 dB(A) twinned while in night mode operation. Units shall have 5 levels sound adjustment via dip switch selectable fan speed settings. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
    d. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.
    e. The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.
    f. The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via

Linear Expansion Valves (LEV) from the heat exchanger.

g. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.

h. VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.

i. The outdoor unit shall be capable of operating in heating mode down to -25ºF ambient temperatures or cooling mode up to 126ºF ambient temperatures, without additional restrictions on line length & vertical separation beyond those published in respective product catalogs. Models with capacity data for required temperature range published as "for reference only" are not considered capable of guaranteed operation and are not acceptable. If an alternate manufacturer is selected, any additional material, cost, and labor to meet ambient operating range and performance shall be incurred by the contractor.

j. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads. Systems which might engage oil return sequence based on hours of operation risk oil return during inopportune periods are not allowed. Systems which rely on sensors (which may fail) to engage oil return sequence are not allowed.

k. Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (below 23F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23F.

l. While in hot gas defrost the system shall slow the indoor unit fan speed down to maintain a high discharge air temperature, systems that keep fan running in same state shall not be allowed as they provide an uncomfortable draft to the indoor zone due to lower discharge air temperatures.

m. The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized snow /hail guard. The snow/hail guard protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.

2. Unit Cabinet

   a. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

   b. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.

   c. Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.

3. Fan

   a. Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only. Fans shall be factory set for operation at 0 in. WG. external static pressure, but capable of normal operation with a maximum of 0.32 in. WG. external static pressure via dipswitch.

   b. All fan motors shall have inherent protection, have permanently lubricated

bearings, and be completely variable speed.

c. All fan motors shall be mounted for quiet operation.

d. All fans shall be provided with a raised guard to prevent contact with moving parts.

e. The outdoor unit shall have vertical discharge airflow.

4. Refrigerant & Refrigerant Piping

a. Refrigerant shall be R410A.

b. Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

c. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.

d. All refrigerant piping must be insulated with minimum ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.

e. Refrigerant line sizing shall be in accordance with manufacturer specifications.

f. Contractor shall submit refrigerant piping diagrams with piping sized by Manufacturer's electronic selection software. Piping lengths shall be based on installed conditions.

5. Coil

a. Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a 4-sided coil

b. Outdoor Coil shall be elevated at least 12" from the base on the unit to protect coil from freezing and snow build up in cold climates. Manufacturer's in which their coil extends to within a few inches from the bottom of their cabinet frame shall provide an additional 12" of height to their stand or support structure to provide equal protection from elements as Mitsubishi Electric basis of design. Any additional support costs, equipment fencing, and tie downs required to meet this additional height shall be responsibility of Mechanical Contractor to provide.

c. The outdoor heat exchanger shall be of zinc coated aluminum construction with turbulating flat tube construction. The coil fins shall have a factory applied corrosion resistant finish. Uncoated aluminum coils/fins are not allowed.

d. The coil shall be protected with an integral metal guard.

e. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

f. Unit shall have prewired plugs for optional panel heaters in order to prevent any residual ice buildup from defrost. Panel heaters are recommended for operating environments where the ambient temperature is expected to stay below -1F for 72 hours.

g. Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture. Manufacturers who do not have an active hot gas circuit in the lower section of the Outdoor coil to protect coil from freezing shall not be allowed to bid on project in markets where the outdoor unit will see temperatures below freezing.

6. Compressor
   a. Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non inverter-driven compressors, which may cause inrush current (demand charges) and require larger generators for temporary power shall not be allowed.
   b. Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load. Manufacturer's that rely on a single compressor discharge port and provide no means of eliminating over compression and energy waste at part load shall not be allowed.
   c. Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting "belly-band" type crankcase heaters are not allowed. Manufacturers that utilize belly-band crankcase heaters will be considered as alternate only.
   d. Compressor shall have an inverter to modulate capacity. The capacity for each compressor shall be variable with a minimum turndown not greater than 15%.
   e. The compressor shall be equipped with an internal thermal overload.
   f. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.
   g. Manufacturers that utilize a compressor sump oil sensor to equalize compressor oil volume within a single module shall not be allowed unless they actively shut down the system to protect from compressor failure.
7. Controls
   a. The unit shall be an integral part of the system & control network described in Controls section and react to heating/cooling demand as communicated from connected indoor units over the control circuit. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.
   b. Each outdoor unit shall have the capability of 4 levels of demand control based on external input
8. Electrical
   a. The outdoor unit electrical power shall be 208/230 or 460 volts, 3-phase, 60 hertz.
   b. The outdoor unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz), 207-253V (230V/60Hz) or 414-506V (460V/60Hz).
   c. The outdoor unit shall be controlled by integral microprocessors.
   d. The control circuit between the indoor units, BC Controller and the outdoor

unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

G. Indoor Unit – 4-Way Ceiling Cassette Type with Grille for 2'x2' Grid

1. General
    a. The indoor unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.
2. Unit Cabinet:
    a. The cabinet shall be a compact 22-7/16" wide x 22-7/16" deep so it will fit within a standard 24" square suspended ceiling grid.
    b. The cabinet panel shall have provisions for a field installed filtered outside air intake.
    c. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
3. Fan
    a. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
    b. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
    c. The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of five (4) speed settings, Low, Mid, High and Auto.
    d. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
    e. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
    f. Grille shall include a factory-installed "i-see" sensor, or equal, to work in conjunction with indoor unit control sequence to prevent unnecessary cooling or heating in unoccupied areas of the zone without decreasing comfort levels. Sensor must detect occupancy (not simply motion) and location of occupants by measuring size & temperature of objects within a 39' detecting diameter (based on 8.8ft mounting height) with 1,856 or more measuring points.
4. Filter:
    a. Return air shall be filtered by means of a long-life washable filter.
    b. Provide a spare filter for each unit.
5. Coil:
    a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat

exchange. All tube joints shall be brazed with phos-copper or silver alloy.

b. The coils shall be pressure tested at the factory.

c. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 19-3/4" inches above the condensate pan.

6. Electrical:
   a. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
   b. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
7. Controls
   a. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
   b. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
   c. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
   d. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.
   e. A factory-installed drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur, the control shuts down the indoor unit before an overflow can occur. A thermistor error code will be produced should the sensor activate indicating a fault which must be resolved before the unit re-starts.

H. Indoor Unit – Medium Static Ceiling Concealed Horizontal Ducted

1. General:
   a. The ceiling-concealed ducted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.
2. Unit Cabinet:
   a. The unit shall be ceiling-concealed, ducted—with a 2-position, field adjustable return and a fixed horizontal discharge supply.
   b. The cabinet panel shall have provisions for a field installed filtered outside air intake.
3. Fan:
   a. Indoor unit shall feature multiple external static pressure settings ranging from 0.14 to 0.60 in. WG.
   b. The indoor unit fan shall be an assembly with statically and dynamically balanced Sirocco fan(s) direct driven by a single motor with permanently lubricated bearings.
   c. The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the

Auto-Fan function

4. Filter:
    a. Return air shall be filtered by means of a standard factory installed return air filter.
    b. Provide optional return filter box (rear or bottom placement) with high-efficiency filter for all PDFY indoor units.
    c. Provide a spare filter for each unit.
5. Coil:
    a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
    b. The coils shall be pressure tested at the factory.
    c. Coil shall be provided with a sloped drain pan. Units without sloped drain pans which must be installed cockeyed to ensure proper drainage are not allowed.
    d. The unit shall be provided with an integral condensate lift mechanism able to raise drain water 27 inches above the condensate pan.
6. Electrical:
    a. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
    b. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
7. Controls:
    a. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
    b. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
    c. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
    d. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

I. Multi-poise fan coil

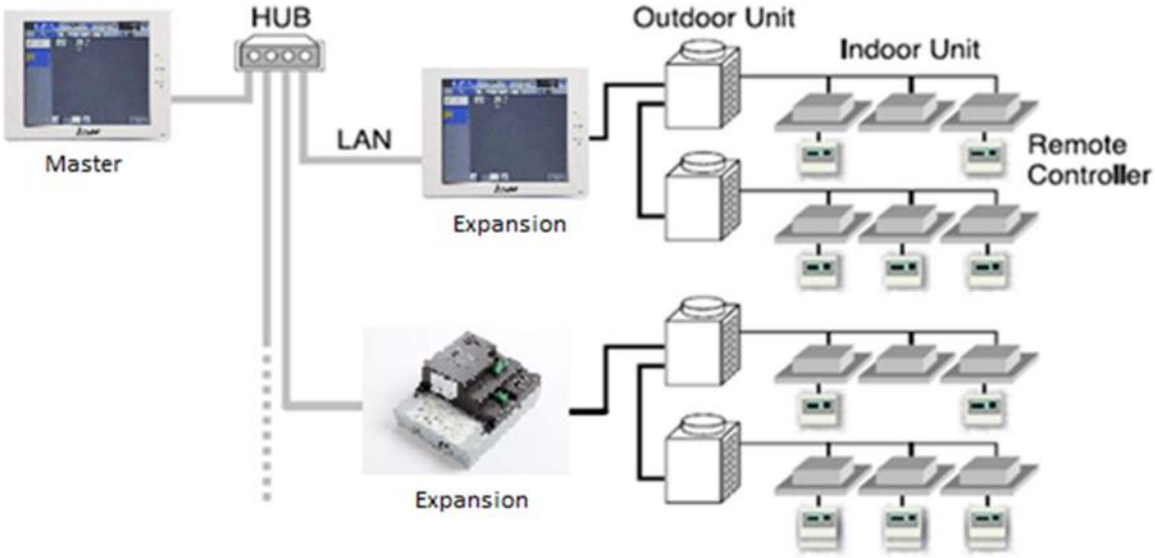
1.

J. Controls

1. General:
    a. The control system shall consist of a low voltage communication network and a web-based interface. The controls system shall gather data and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
    b. Furnish energy conservation features such as optimal start, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.

c. System shall be capable of email generation for remote alarm annunciation.

2. Electrical Characteristics:
   a. General
      1 Controller power and communications shall be via a common non-polar communications bus and shall operate at 30VDC.
   b. Wiring:
      1 Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
      2 Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.
   c. Wiring type:
      1 Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.
      2 Network wiring shall be CAT-5 with RJ-45 connection.
3. CITY MULTI Controls Network:
   a. The CITY MULTI Controls Network (CMCN) consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The CITY MULTI Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces. The below figure illustrates a sample CMCN System Configuration.



CMCN System Configuration

K. Simple MA Remote Controllers

1. The Backlit Simple MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group).
2. The Backlit Simple MA Remote Controller shall only be used in same group with Wireless MA Remote Controllers or with other Backlit Simple MA Remote Controllers, with up to two remote controllers per group.

Simple MA Remote Controller			
Item	**Description**	**Operation**	**Display**
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Operation Mode	Switches between Cool/Drying/Auto/Fan/Heat/Setback. Operation modes vary depending on the air conditioner unit. Auto and Setback mode are available for the R2/WR2-Series only.	Each Group	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit. Separate COOL and HEAT mode set points available depending on central controller and connected mechanical equipment.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Group	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *1: Centrally Controlled is displayed on the remote controller for prohibited functions.	N/A	Each Group *1
Display Indoor Unit Intake Temp	Measures and displays the intake temperature of the indoor unit when the indoor unit is operating.	N/A	Each Group
Display Backlight	Pressing the button lights up a backlight. The light automatically turns off after a certain period of time. (The brightness settings can be selected from Bright, Dark, and Light off.)	N/A	Each Unit
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed	N/A	Each Unit
Test Run	Operates air conditioner units in test run mode. *2 The display for test run mode will be the same as for normal start/stop (does not display “test run”).	Each Group	Each Group *2
Ventilation Equipment	Up to 16 indoor units can be connected to an interlocked system that has one LOSSNAY unit.	Each Group	N/A
Set Temperature Range Limit	Set temperature range limit for cooling, heating, or auto mode.	Each Group	Each Group

L. Centralized Controller (Web-Enabled)

1. Master Centralized Controller

a. The Master Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple CITY MULTI outdoor units with the use of three expansion controllers. The Master Centralized Controller shall be approximately 11-5/32" x 7-55/64" x 2-17/32" in size and shall be powered with an integrated 100-240 VAC power supply. The Master Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the Master Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the Master Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, fan speed setting, and airflow direction setting. Since the master provides centralized control, it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the Master Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

Master Centralized Controller			
Item	**Description**	**Operation**	**Display**
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Switches between Cool/Dry/Auto/Fan/Heat. (Group of Lossnay unit: automatic ventilation/vent-heat/interchange/normal ventilation) Operation modes vary depending on the air conditioner unit. Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group
Temperature Setting	Sets the temperature from 57°F – 87°F depending on operation mode and indoor unit.	Each Block, Group or Collective	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Block, Group or Collective	Each Group

Master Centralized Controller			
Item	**Description**	**Operation**	**Display**
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *2. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Night Setback Setting	The function helps keep the indoor temperature in the temperature range while the units are stopped and during the time this function is effective.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group. Space temperature displayed on the indoor unit icon on the touch screen interface.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection	N/A	*4 Each Unit or Collective
Outdoor Unit Status	Compressor capacity percentage and system pressure (high and low) pressure (excludes S-Series)	Each ODU	Each ODU
Connected Unit Information	MNET addresses of all connected systems	Each IDU, ODU and BC	Each IDU, ODU and BC
Ventilation	This interlocked system settings can be performed by the master system controller.	Each Group	Each Group

Master Centralized Controller			
Item	**Description**	**Operation**	**Display**
Equipment	When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between “Hi”, “Low” and “Stop”. When setting a group of only free plan LOSSNAY units, you can switch between “Normal ventilation”, “Interchange ventilation” and “Automatic ventilation”.		
Multiple Language	Other than English, the following language can be chosen. Spanish, French, Japanese, Dutch, Italian, Russian, Chinese, and Portuguese are available.	N/A	Collective
External Input / Output	By using accessory cables you can set and monitor the following. Input By level: “Batch start/stop”, “Batch emergency stop” By pulse: “batch start/stop”, “Enable/disable remote controller” Output: “start/stop”, “error/Normal” *5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.	*5 Collective	*5 Collective

b. All Master Centralized Controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three expansion controllers for display of up to two hundred (200) indoor units on the main master centralized controller interface.

c. The Master Centralized Controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.

d. Standard software functions shall be available so that the building manager can securely log into each master centralized controller via the PC’s web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Additional optional software functions of personal browser for PCs and MACs and Energy shall be available but are not included. The Energy Apportionment function shall require a LIC-Charge software license

2. Expansion Controller

a. The Expansion Controller shall serve as a standalone centralized controller or as an expansion module to the Master Centralized Controller for the purpose of adding up to 50 indoor units to the main touch screen interface of the master centralized controller. Up to three (3) expansion controllers can be connected to the master via a local IP network (and their IP addresses assigned on the master) to the master to allow for up to two hundred (200) indoor units to be monitored and controlled from the master interface.

b. The expansion controllers have all of the same capabilities to monitor and control their associated indoor units as the features specified above. Even when connected to the master and configured to display their units on the main controller, the individual indoor units connected to the expansion can still be monitored and controlled from the interface of the expansion. The last

command entered will take precedence, whether at the wall controller, the expansion or the master Centralized Controller.

3. Non Touch Screen, Networked Centralized Controller:
   a. The Non Touch Screen, Networked Centralized Controller shall be capable of controlling a maximum of 50 indoor units across multiple CITY MULTI outdoor units. The controller shall be approximately 8-1/2"x10" in size and shall be powered by its internal power supply. The controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, free contact interlock configuration and malfunction monitoring. The controller shall have five basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, temperature setting, fan speed setting, and airflow direction setting. Since the controller provides centralized control, it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the controller shall allow the user to define both daily and weekly schedules with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Indoor unit modes: COOL/DRY/FAN/AUTO/HEAT. Lossnay unit modes: HEAT RECOVERY/BYPASS/AUTO Air to water (PWFY) modes: HEATING/HEATING ECO/HOT WATER/ANTI-FREEZE/COOLING *Operation modes vary depending on the unit model connected. ** Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit model. Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.	Each Block, Group or Collective	Each Group
Set Temperature Range Limit	The range of room temperature setting can be limited by the initial setting depending on the indoor unit connected.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depend on indoor unit model.	Each Block, Group or Collective	Each Group
Air Flow Direction Setting	*Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each	Each Group

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
		Block, Group or Collective	
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *2. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Hold	Disables scheduled functions for indoor unit groups and their associated remote controller timers. *not available for general equipment	Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Fan Speed, Air Direction and Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group.	N/A	Each Group
Room Humidity	Displays the percent relative humidity in the space as sensed by the Smart ME Remote Controller	N/A	Each Group
Occupancy Sensor	Displays the occupancy icon on the group icon in the condition list page when the room is occupied (blue) or vacant (gray). *The Smart ME Remote Controller Occupancy sensor is required.	N/A	Each Group
Brightness Sensor	Displays the brightness icon on the group icon in the condition list when the space is determined to be bright (yellow) or dark (gray). *The Smart ME Remote Controller Brightness sensor is required.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code	N/A	*4 Each Unit or Collective

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
	and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection		
Ventilation Equipment	This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between "Hi", "Low" and "Stop". When setting a group of only free plan LOSSNAY units, you can switch between "Normal ventilation", "Interchange ventilation" and "Automatic ventilation".	Each Group	Each Group
Multiple Language	Other than English, the following languages can be selected: Spanish, French, Japanese, German, Italian, Russian, Chinese, and Portuguese.	N/A	N/A
External Input / Output	By using accessory cables you can set and monitor the following. Input: By level: "Batch start/stop", "Batch emergency stop"; By pulse: "batch start/stop", "Enable/disable remote controller" Output: "start/stop", "error/Normal" *5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.	*5 Collective	*5 Collective
M-Net	The "M-NET" LED lights, when AC power supply is turned ON. The LED blinks while M-NET is communicating.	N/A	Each Group (LED)
Collective ON/OFF	All the units can be operated / stopped with a DIP switch.	Collective	N/A
Measurement	Displays the Temperature and Humidity inputs of the AI Board. Supports graph display and data export.	N/A	Each Unit
AHC Status	Displays the status of the of the inputs and outputs of each Advanced HVAC Controller (DC-A2IO)	N/A	Each Unit
Free Contact Status	Displays the input/output status of the Free Contacts on the indoor units	N/A	Each Unit
Free Contact Interlock Control	Operation of indoor groups, general equipment or free contact outputs based on group(s) conditions or free contact(s) input states.	Each Group, Output or Collective	N/A
Data Back-up (PC)	Initial setting data can be exported to a PC.	Collective	N/A

b. All Non Touch Screen, Networked Centralized Controller shall be equipped with two RJ-45 Ethernet port to support interconnection with a network PC and BACnet/IP communication via a closed/direct Local Area Network (LAN). The controller shall be capable of performing initial settings online via a PC using the controller's initial setting browser or online/offline with the Initial Setting Tool.

c. Standard software functions shall be available so that the building manager can securely log into each controller via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online

maintenance diagnostics. Standard software functions shall not expire. Additional optional software functions of personal browser for PCs and MACs and Energy Allocation shall be available. The Energy Allocation function shall require Master Centralized Controller Energy Allocation Integrated System in conjunction with Non Touch Screen, Networked Centralized Controller.

M. Graphical User Interface

1. Front End Computer:
    a. The Graphical User Interface (Integrated Centralized Web Control) shall require a filed supplied PC or Tablet.
    b. Contractor to include the provision of this computer or tablet.
2. ICCW
    a. The Integrated Centralized Control Web System (ICCW) interface shall enable the user to control multiple networked central controllers and shall provide additional functions such as energy apportionment from a single network PC configured with the Charge Calculation Tool. The ICCW shall be capable of controlling up to forty networked Centralized Controllers with a maximum of 2,000 indoor units across multiple CITY MULTI outdoor units. The ICCW shall be required if the user wants to simultaneously control more than 1 Centralized Controllers from a single PC or tablet using a single web browser session. Licensing per function, per Centralized Controller shall be required for the ICCW. Optional software features shall be available through the ICCW including energy apportionment and personalized web. These optional software features shall require the ICCW, advance purchase from the customer, and licensing from ICCW.

ICCW (Integrated System Software)	
Item	**Details**
ON/OFF	The units can turn ON and OFF for all floors or in a block, floor, or group of units.
Operation Modes	The operation mode can be switched between COOL, DRY, FAN, AUTO, and HEAT for all floors or in a block, floor, or group of units
Temperature Setting	Sets the temperature for a single group. Range of Temperature setting from 57°F – 87°F depending on operation mode and indoor unit model. Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.
Fan Speed	The fan speed can be set to four stages for all floors or in a block, floor, or group of units
Air Direction	The air direction can be set in four vertical directions or to swing for all floors or in block, floor, or group of units. (The selectable air direction differs according to the model.)
Interlocked Unit ON/OFF LOSSNAY	If there is an interlocked unit (LOSSNAY), then the unit can be turned ON (strong/weak) or OFF for all floors or in a block, floor, or group of units. (Note that the ventilation mode cannot be selected for interlocked units.)
Local Operation Prohibit	The items for which operation with the local remote controller are to be prohibited can be selected for all floors or in a block, floor, or group of units. (The items that can be prohibited are ON/OFF, operation mode, set temperature and filter sign reset.)

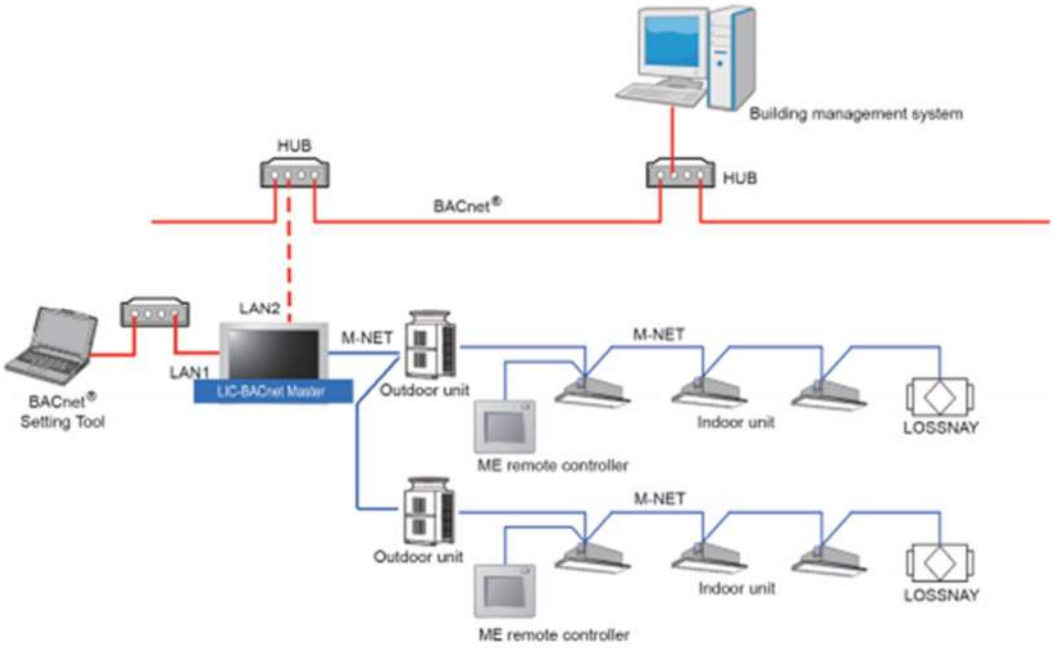
ICCW (Integrated System Software)	
Item	**Details**
Annual / Weekly Schedule	The annual/weekly schedule function can be used by registering the license. Two settings, such as seasonal settings for summer and winter, can be saved.
Power Rate Apportionment Charging	A watt-hour meter (WHM) with kWH pulse output is connected to calculate the air conditioning charges based on the amount each tenant's air-conditioner has operated. Five charging rates can be applied per day. ***OPTIONAL ENERGY APPORTIONMENT SOFTWARE (LIC-CHARGE) and PI Controller (PAC-Y60MCA) REQUIRED
History	Up to 3,000 items for the error history and up to 10,000 items for operation history can be saved. Each history file can be output as a daily report or monthly report in CSV format. (The operation history consists only of the operations carried out with the ICCW and is limited to some limited operation items.)
Operation Time Monitor	The cumulative operation time of each indoor unit can be viewed or output as a CSV format file. (This function is valid only when the charging function license is registered.)
Filter Sign Display Mask	The filter sign display at the remote controllers can be disabled.
Set Temperature Limit	The set temperature lower limit can be set for cooling and the upper limit for heating. (ME remote controller required)

N. CMCN: System Integration

1. BACnet® Integration:
   a. The Mitsubishi Electric Cooling & Heating BACnet® hardware, which is built into all networked central controllers, shall be compliant with BACnet® Protocol (ANSI/ASHRAE 135-2010) and be Certified by the (BTL) BACnet® Testing Laboratories. The BACnet® interface shall support BACnet Broadcast Management (BBMD). The BACnet® interface shall support a maximum of 50 indoor units. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address.
2. Licenses:
   a. LIC-BACnet Master: Master Controller license for Master Centralized Controller and Non Touch Screen, Networked Centralized Controller
   b. LIC-BACnet Expansion: Expansion Controller license for Expansion Controller and Non Touch Screen, Networked Centralized Controller
3. LIC-BACnet Specifications:
   a. Control up to 50 groups
   b. 1 to 16 indoor units can be collectively controlled in a group
   c. Supports dual set point functionality (connected model dependent)
   d. BTL Compliant
   e. BACnet communication specifications are based on ANSI/ASHRAE Standards 135-2010
4. PC Requirements:
   a. CPU: 1GHz or higher
   b. Memory: 1GB or more

c. HDD Space: 100 MB or more
d. Screen Resolution: 1024 x 768 or higher
e. OS: Microsoft Windows 7 32-bit/64-bit, Microsoft 8.1 32-bit/64-bit. Not compatible with Windows Vista
f. Execution Environment: Microsoft .NET Framework 4.5 or later
g. Others: Pointing device such as a mouse, internet connection (required when installing a .NET Framework)

5. LIC-BACnet – System Example



6. BACnet Point List

Object List
On Off Setup
On Off State, Number of ON/OFF, Cumulative operation time
Alarm Signal (4-digit error code)
Error Code
Operational Mode Setup
Operational Mode State
Fan Speed Setup
Fan Speed State
Room Temp [Water Temp]
Set Temp [Set Water Temp]
Set Temp Cool
Set Temp Heat
Set Temp Auto
Filter Sign [Circulating Water Exchange Sign]
Filter Sign Reset [Circulating Water Exchange Sign Reset]
Prohibition On Off
Prohibition Mode

Prohibition Filter Sign Reset [Prohibition Circulating Water Exchange Sign Reset]
Prohibition Set Temperature
M-NET Communication State
System Forced Off
Air Direction Setup
Air Direction State
Set High Limit Setback Temp
Set Low Limit Setback Temp
Ventilation Mode Setup
Ventilation Mode State
Air To Water Mode Setup
System Alarm Signal (4-digit error code)
PI Controller Alarm Signal (4-digit error code)
Group Apportioned Electric Energy
Interlocked Units Apportioned Electric Energy
PI controller Electric Energy 1–4
Pulse Input Electric Energy 1–4
Group Apportionment Parameter
Interlocked Units Apportionment Parameter
Night Purge State
Thermo On Off State
Trend Log Room Temp
Trend Log Group Apportioned Electric Energy
Trend Log Interlocked Units Apportioned Electric Energy
Trend Log PI controller Electric Energy 1–4
Trend Log Pulse Input Electric Energy 1–4
Trend Log Group Apportionment Parameter
Trend Log Interlocked Units Apportionment Parameter

2.35 ROOF MOUNTED ENERGY RECOVERY VENTILATOR (Gymnasium)

A. General

1. This section includes units with split DX heat pump heating and cooling for outdoor installation. Integral Energy Recovery device shall be a rotary air-to-air total enthalpy wheel. Airflow arrangement shall be Outdoor Air with Recirculation. Each unit shall be constructed in a horizontal configuration and shall incorporate additional product requirements as listed in this specification.

B. Manufacturers

1. Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include, but are not limited to:
   a. Mitsubishi Electric US, Inc.
   b. Greenheck Fan Corporation
   c. AAON

C. Manufactured Units

1. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, downturn outdoor air intake with 2" aluminum mesh filter assembly,

exhaust air blower, evaporator coil, energy wheel, phase and brownout protection, motorized dampers, motorized recirculating damper, curb assembly, filter assembly intake air, supply air blower assembly, exhaust/relief blower assembly, filter assembly for exhaust air, and an electrical control center. All specified components and internal accessories factory installed are tested and prepared for single-point high voltage connection.

a. Option to field install DX coil.

D. Cabinet

1. Materials: Formed, double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
   a. Unit's exterior shall be supplied from the manufacturer using G60 galvanneal steel with proprietary pre-painted material in the following finish color; Concrete Gray-RAL 7023. This has been subjected to a salt spray test per ASTM-B117 and evaluated using ASTM-D714 and ASTM-D610 showing no observable signs of rust or blistering until reaching 2,500 hours. Uncoated galvanized steel exterior is not acceptable.
   b. Internal assemblies: 22 gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.
2. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
   a. Materials: Rigid urethane injected foam. Foam board not acceptable.
      1 Thickness: 2 inch (50.8 mm)
      2 Thermal Resistance R13
      3 Thermally broken
      4 Meets UL94HF-1 flame requirements.
      5 Location and application: Full coverage of entire cabinet exterior to include walls, roof of unit, unit base, and doors.
   b. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
      1 Thickness: 2 inch (50.8 mm)
      2 Thermal Resistance R8
      3 Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
      4 Location and application: Divider panels between outdoor air and return air/exhaust air streams.
3. Roof Insulation:
   a. 2 inch (50.8 mm) fiberglass located above the 1 inch (25.4 mm) foam panel.
4. Access panels / doors:
   a. Unit shall be equipped with insulated, hinged doors to provide easy access to all major components. Doors and access panels shall be fabricated of 18 gauge galvanized G90 steel or painted galvannealed steel.
5. Supply Air blower assemblies:
   a. Blower assembly shall consist of an electric motor and direct-drive fans. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motors shall be capable of continuous speed modulation and controlled by a VFD.

6. Exhaust Air blower assemblies:
    a. Blower assembly shall consist of an electric motor and a direct-drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motor shall be capable of continuous speed modulation and controlled by a VFD.
7. VRF Heat Pump unit
    a. Refer to Mitsubishi heat pump specification for requirements for this unit.
8. Evaporator Coil:
    a. Evaporator coil shall be sized and provided by the VRF heat pump manufacturer.
9. Control panel / connections:
    a. Units shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections. RTU shall be equipped with a Unit Disconnect Switch.
10. Condensate drain pan:
    a. Drain Pan shall be an integral part of the unit. Pan shall be formed of welded austenitic stainless steel sheet material and provided with a welded stainless steel drain connection at the front for connection to a P trap. Drain pan shall be sloped in two directions to provide positive draining and drain connector shall be sealed at penetration through cabinet wall.
11. P trap:
    a. If the unit is equipped with a condensate drain pan, contractor shall provide, or fabricate, and install an appropriate P trap, in accordance with all local and area codes and Best Practices.
12. Energy wheel:
    a. Unit energy wheel shall be sized for the full volume of outdoor and exhaust air without an energy wheel bypass damper(s). Bypass dampers are only acceptable during economizer operation – they cannot be used during normal operation.
    b. Energy wheel shall be of total enthalpy, rotary air-to-air type and shall be an element of a removable energy wheel cassette. The cassette shall consist of a galvanized steel framework (designed to produce laminar air flow through the wheel), an energy wheel as specified and a motor and drive assembly. The cassette shall incorporate a pre-tensioned urethane drive belt or a link style belt with a five-year warranty. The wheel media shall be a polymer film matrix in a stainless-steel framework and be comprised of individual segments that are removable for servicing. Non-segmented energy wheels are not acceptable. Silica gel desiccant shall be permanently bonded to the polymer film and is designed and constructed to permit cleaning and servicing. The energy wheel is to have a five-year warranty. Performance criteria are to be as specified in AHRI Standard 1060, complying with the Combined Efficiency data in the submittal.
13. Modulating frost control.
    a. Control system shall include an outdoor air thermostat and pressure sensor on the wheel assembly to initiate frost control sequence.
14. Electric Post-heater

a. Post-heater shall be SCR control and shall include a temperature sensor with field adjustable set point, located in the outdoor air stream. Heat output of the post-heater shall be infinitely variable. Electric post-heater shall be able to simultaneously operate with the air-source heat pump for dehumidification mode reheat.

15. Phase and brownout protection: Unit shall have a factory-installed phase monitor to detect electric supply phase loss and voltage brown-out conditions. Upon detection of a fault, the monitor shall disconnect supply voltage to all motors.
16. Motorized dampers / Intake Air, Motorized dampers of low leakage type shall be factory installed.
17. Motorized Recirculating Air Damper designed to permit 100% recirculation of exhaust air shall be factory installed.
18. Curb Assembly:
    a. Refer to vibration isolation roof curb requirements.
    b. Base of unit shall be minimum 12” above roof line (top of insulation).
19. UV Lights:
    a. UV-C lights are factory-mounted and access door kill switches are included.

E. Blower

1. Blower section construction, Supply Air: direct drive motor and blower shall be assembled on a 14 gauge galvanized steel platform and shall be equipped with 1.125 inch thick neoprene vibration isolation devices.
2. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
3. Fan: Direct drive, airfoil plenum fan with aluminum wheel statically and dynamically balanced. Prop or belt-drive fan not acceptable due to low static capabilities.
4. Blades: Welded aluminum blades only.
5. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".

F. Motors

1. General: Blower motors greater than 1/2 horsepower shall be "NEMA Premium" unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure.
2. Motors shall be 60 cycle, 3 phase 208 volts.

G. Unit Controls

1. The unit shall be constructed so that it can be operated as a heating and cooling system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.
2. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status. DDC controller shall have a built-in keypad to permit operator

to access read-out screens without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable. Owner-specified ventilating conditions can be input by means of pushbuttons.

3. Unit supply fan shall be configured for Constant Volume (ON/OFF).
4. Unit exhaust fan shall be configured for damper tracking.
5. Room thermostat shall be provided as a shipped loose item. The room thermostat shall have an LCD display to adjust the room temperature set point from within the space. The room thermostat shall average four (4) temperature sensors and one (1) relative humidity sensor.
6. Outside Air / Return Air damper control shall be CO2 sensor by DDC Contractor.
7. Economizer control shall be temperature / enthalpy.
8. Dirty filter sensor shall be factory installed.
9. Variable Frequency Drive (VFD): unit shall have factory installed variable frequency drive for modulation of the supply and exhaust air blower assemblies. The VFD shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.
10. Airflow monitoring required in the outdoor airstreams.
11. A web user-interface (web UI) must be available for the manufacturer installed controls. The interface can be accessed via a web browser (when an Ethernet cable is connected to the building network) or to a laptop plugged in directly to the controller. Web UI must have the following features available which allow simple access to the unit, improved startup / commissioning and provide quick troubleshooting capabilities:
    a. Graphical overview screen for easy access to current conditions and set point changes
    b. All sensor values, set point and control outputs recorded each minute with 1 week of history stored on the controller for simple troubleshooting
    c. Refrigeration details screen with compressor status, temperature and pressure readings
    d. Access to current alarms and alarm history
    e. Service override capabilities to manually change I/O and verify proper operation of the unit.

H. Filters

1. Unit shall have permanent metal filters located in the outdoor air intake and shall be accessible from the exterior of the unit.
2. MERV 8 disposable pleated filters shall be provided in the supply air stream.
3. MERV 8 and MERV 13 disposable pleated filters shall be provided in the supply final air stream and MERV 8 filters in the exhaust air stream.

I. Start-up Service

1. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

J. Demonstration and Training

1. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

2.36 HIGH EFFICIENCY SPLIT HEAT PUMP, AIR COOLED

A. Heat pumps shall provide heating and cooling to the Energy Recovery Ventilators. Refer to plans for quantity, capacity and ERV served.

B. General

1. Per the equipment schedule, the variable capacity, heat pump air conditioning system basis of design is Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system(s).
2. Acceptable alternative manufacturers, assuming compliance with these equipment specifications, are Trane, Panasonic, and Hitachi. Contractor bidding an alternate manufacturer does so with full knowledge that that manufactures product may not be acceptable or approved and that contractor is responsible for all specified items and intents of this document without further compensation.
3. The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section and Part 5 (Controls). The outdoor unit modules shall be equipped with a single compressor which is inverter- driven and multiple circuit boards—all of which must be manufactured by the branded VRF manufacturer. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.
4. Outdoor unit systems may be comprised of multiple modules with differing capacity if a brand other than basis of design is proposed. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.
5. Outdoor unit shall have a sound rating no higher than 68 dB(A) individually or 69.5 dB(A) twinned. Units shall have a sound rating no higher than 55 dB(A) individually or
6. 55.5 dB(A) twinned while in night mode operation. Units shall have 5 levels sound adjustment via dip switch selectable fan speed settings. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
7. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.
8. The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.
9. The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via Linear Expansion Valves (LEV) from the heat exchanger.
10. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.

11. VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.
12. The outdoor unit shall be capable of guaranteed operation in heating mode down to - 25F ambient temperatures and cooling mode up to 126# F without additional restrictions on line length & vertical separation beyond those published in respective product catalogs. Models with capacity data for required temperature range published as "for reference only" are not considered capable of guaranteed operation and are not acceptable. If an alternate manufacturer is selected, any additional material, cost, and labor to meet ambient operating range and performance shall be incurred by the contractor.
13. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads. Systems which might engage oil return sequence based on hours of operation risk oil return during inopportune periods are not allowed. Systems which rely on sensors (which may fail) to engage oil return sequence are not allowed.
14. Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (below 23F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23F.
15. While in hot gas defrost the system shall slow the indoor unit fan speed down to maintain a high discharge air temperature, systems that keep fan running in same state shall not be allowed as they provide an uncomfortable draft to the indoor zone due to lower discharge air temperatures.

C. Unit Cabinet

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
2. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.
3. Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.

D. Fan:

1. Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only. Fans shall be factory set for operation at 0 in. WG external static pressure, but capable of normal operation with a maximum of 0.32 in. WG external static pressure via dipswitch.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fans shall be provided with a raised guard to prevent contact with moving parts.

E. Refrigerant and Refrigerant Piping

1. R410A refrigerant shall be required for systems.

2. Polyolester (POE) oil—widely available and used in conventional domestic systems— shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
3. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.
4. All refrigerant piping must be insulated with ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.
5. Refrigerant line sizing shall be in accordance with manufacturer specifications

F. Coil

1. Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a 4-sided coil.
    a. Outdoor Coil shall be elevated at least 12" from the base on the unit to protect coil from freezing and snow build up in cold climates. Manufacturer's in which their coil extends to within a few inches from the bottom of their cabinet frame shall provide an additional 12" of height to their stand or support structure to provide equal protection from elements as Mitsubishi Electric basis of design. Any additional support costs, equipment fencing, and tie downs required to meet this additional height shall be responsibility of Mechanical Contractor to provide.
    b. The outdoor heat exchanger shall be of zinc coated aluminum construction with turbulating flat tube construction. The coil fins shall have a factory applied corrosion resistant finish. Uncoated aluminum coils/fins are not allowed.
    c. The coil shall be protected with an integral metal guard.
    d. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
    e. Unit shall have prewired plugs for optional panel heaters in order to prevent any residual ice buildup from defrost. Panel heaters are recommended for operating environments where the ambient temperature is expected to stay below -1F for 72 hours.
    f. Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture. Manufacturers who do not have an active hot gas circuit in the lower section of the Outdoor coil to protect coil from freezing shall not be allowed to bid on project in markets where the outdoor unit will see temperatures below freezing.

G. Compressor:

1. Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non inverter-driven compressors, which may cause inrush

current (demand charges) and require larger generators for temporary power shall not be allowed.

2. Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load. Manufacturer's that rely on a single compressor discharge port and provide no means of eliminating over compression and energy waste at part load shall not be allowed.
3. Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting "belly-band" type crankcase heaters are not allowed. Manufacturers that utilize belly-band crankcase heaters will be considered as alternate only.
4. Compressor shall have an inverter to modulate capacity. The capacity for each compressor shall be variable with a minimum turndown not greater than 15%.
5. The compressor shall be equipped with an internal thermal overload.
6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.
7. Manufacturers that utilize a compressor sump oil sensor to equalize compressor oil volume within a single module shall not be allowed unless they actively shut down the system to protect from compressor failure.

H. Controls

1. The unit shall be an integral part of the system & control network described in Part 5 (Controls) and react to heating/cooling demand as communicated from connected indoor e control circuit. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.
2. The outdoor unit shall have the capability of 4 levels of demand control for each refrigerant system based on external input.

I. Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz or 460 volts, 3-phase, 60 hertz per equipment schedule.
2. The outdoor unit shall be controlled by integral microprocessors.
3. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

J. System Start-Up

1. The manufacturer or manufacturer's representative shall provide start-up services for the system and shall provide a report on the start-up procedure and provide documentation that the system is installed and functioning per the manufacturer's specifications.
2. The manufacturer or manufacturer's representative shall provide integration system assistance as required to assist the ATC sub-contractor in integrating the VRV system with the DDC system.

K. System Training

1. The manufacturer or manufacturer's representative shall provide training for the Owner or Owner's representative. Training shall be a minimum of 4 hours and shall be conducted at the same time as the training for the other HVAC systems.

2. The manufacturer shall also provide 16 hours of structured off-site training for the Owner's personnel.

L. Warranty

1. The CITY MULTI units shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and seven (7) year compressor to the original owner from date of installation.
2. Installing contractor shall meet manufacturer requirements to obtain extended manufacturer's limited parts and compressor warranty for a period of ten (10) years to the original owner from date of installation. This warranty shall not include labor.
3. All manufacturer's requirements to obtain the limited warranty shall be met, including but not limited to: designed by a certified City Multi Diamond Designer, installation by a contractor that has completed the Mitsubishi service course, and submission of a completed commissioning report that is approved by Mitsubishi.
4. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.
5. The CITY MULTI VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

2.37 DX COILS FOR AHU-111

A. DX coils for ERV's shall be designed and provided by the VRF air source heat pump unit provider for installation in the ERV units. Refer to the plans and schedules for quantities, capacities and circuiting requirements.

1. Basis of design is Heatcraft (Modine) as provided by Mitsubishi.

B. DESIGN PRESSURES AND TEMPERATURES

1. Coils shall be designed to withstand 250 psi maximum operating pressures and a maximum temperature of 300°F for standard duty copper tube coils with standard headers. Higher limits are available, depending on coil construction and / or materials used.

C. FACTORY TESTING REQUIREMENTS

1. Coils are to be pressurized and then completely submerged in warm water containing special wetting and final cleaning agents for leak testing and tested with a minimum of 320 psi air pressure for standard copper tube coils. A hydrostatic leak test is available upon request. Certified hydrostatic leak test and Certificate of Conformance are also available upon request. Coils must display a tag with the inspector's identification as proof of testing. Upon request, after the coils have been tested they can receive a 5 lb. Nitrogen charge assuring the coil as received remains leak free and clear of internal contamination.

D. FINS

1. Coils shall be of plate fin type construction providing uniform support for all coil tubes. Coils are to be manufactured with die-formed aluminum, copper, cupro-nickel, stainless steel or carbon steel fins with self-spacing collars, which

completely cover the entire tube surface. Any manufacturer not capable of offering the full range of these materials shall be considered as unacceptable.

2. Fin corrugations available shall include: Flat, Rippled and "Hi-F" Sine Wave for coils built with 0.625" OD tubes and utilizing a 1.5" equilateral tube pattern; Flat, Rippled and "Hi-F" Sine Wave for coils built with 0.50" OD tubes and utilizing a 1.25" equilateral tube pattern; "Hi-F" Sine Wave for coils built with 0.50" OD tubes and utilizing a 1.5" equilateral tube pattern; Rippled and "Hi-F" Sine Wave for coils built with 0.375" OD tubing and utilizing a 1.0" equilateral tube pattern; "Hi-F" Sine Wave for coils built with 0.375" OD tubes and utilizing a 1.25" equilateral tube pattern; Raised Lance for coils built with 0.375" OD tubing and utilizing a 1.0" equilateral tube pattern. Manufacturers not capable of producing the full range of these fin surface styles, corrugations and tube patterns shall be considered as unacceptable.
3. Standard fin thickness' available shall include: 0.0060" +/- 5% for aluminum and copper; 0.0075" +/- 5% for aluminum, copper, and cupro-nickel, carbon steel and stainless steel; 0.0095" +/- 5% for aluminum, copper, carbon steel and stainless steel; 0.016" +/- 5% for aluminum and copper. Manufacturers not capable of providing the full range of these fins thicknesses shall be considered as unacceptable.
4. Fins are to be formed with full collar on all of available materials, corrugation styles, tube diameters and tube patterns. Manufacturers unable of providing full collars on the full range of fin offerings shall be considered as unacceptable.
5. Fin spacing available shall include: 6-14 fins / inch on coils supplied with 0.625" OD tubing; 7-18 fins / inch on coils supplied with 0.50" OD tubing; 6-24 fins / inch on coils supplied with 0.375" OD tubing. Manufacturers with tooling not capable of providing full collar, die formed fins, accurately space with a tolerance of +/- 4% and not offering the full range fin spacing for the appropriate tube diameter shall be considered as unacceptable.

E. TUBING

1. All tubing and return bends shall be fabricated from UNS 12200 seamless copper conforming to ASTM B75 for standard pressure and temperature applications. Elevated duty and special application construction tube cores shall be available in seamless 90/10 Cupro-Nickel Alloy #706, Stainless Steel ASTM #A249 grade 304L or 316L and Carbon Steel ASTM #A214 welded or #A179 Seamless.
2. Core tubes (excluding hot dipped galvanized steel coils) shall be mechanically expanded to form an interference fit within the fin collars. Expansion shall not decrease the tube wall thickness.
3. Coils shall be manufactured using return bends of the same material as the core tubing. Return bend wall thickness, at the outside circumference of the bend, shall be no less than the core tube wall thickness.
4. Available tube size and wall thickness shall be as follows:

Material	0.375" O.D.	0.50" O.D.	0.625" O.D.
Copper	0.013, .016, .020, 0.025, 0.030	0.016, 0.022, 0.030	0.020, 0.025, 0.035, 0.049
Cupro-Nickel			0.020, 0.035, 0.049

Carbon Steel			0.035, 0.049, 0.065
Stainless Steel			0.035, 0.049, 0.065
Admiralty Brass			0.049

5. Coils shall be made available with copper tubes utilizing internally enhanced Rifled Surfacing when required. As a quality control measure, Coil Manufacturer shall be capable of providing copper rifled tubing, enhanced within it's own facility, and not supplied by an outside source.
6. Available distributor tube size and wall thicknesses shall be as follows:

Material	0.188" O.D.	0.25" O.D.	0.312" O.D.
Copper	0.028	0.028	0.030
Stainless Steel		0.035	0.035
Carbon Steel		0.035	

F. HEADERS

1. Headers shall be constructed from UNS 12200 seamless copper conforming to ASTM B75 and B251 with an H55 temper for standard applications. Other option for headers for high-pressure construction shall incorporate seamless 90/10 Cupro-Nickel Alloy #706 conforming to ASTM B111, Carbon Steel conforming to ASTM A53A or A135A, Stainless Steel conforming to ASTM A249, at Sch. 10 or Sch. 40, per the application requirements.
2. Headers shall be manufactured using a Pierce and Flare die-punch method when possible. This shall insure that the tube-to-header tube hole intrusions into the header are such that the landed surface area contact length for joint brazing approximates three times the core tube wall thickness. Manufacturers not capable of providing headers of the Pierce and Flare design shall be considered as unacceptable.
3. Standard construction shall be such that the core tubes will penetrate directly into the header without the use of intermediate adapter tube studs, except when necessary. Each of the tubes shall extend evenly within the inside diameter of the header between 0.12" and 0.75" depending on OD of tubes. In addition, on 0.375" OD tube coils, each tube shall pass through an oversized hole in the sheet metal casing of no less than 25% larger than the outside diameter of the core tube. This will prevent metal to metal contact between the tube and the sheet metal casing, allowing the header and core tubes to "float" and eliminating the possibility of premature failure caused by excess vibration. Manufacturers not capable of providing such floating headers shall be considered as unacceptable.
4. End caps shall be precision die-formed and positioned inside the header so that the thickness of the brazed fillet joint approximates three times that of the header wall thickness. Manufacturers using standard copper tube end caps, which are brazed over the outside of the end of the headers, shall be considered as unacceptable.

G. CONNECTIONS

1. Standard construction of copper tube condenser coils shall allow for copper sweat connections for type L or K wall copper. Other materials shall be made available dependent upon the materials of construction of the tube core.

H. BRAZING & WELDING

1. Oxyfuel gas brazing, using fillet rod material of minimum 5% silver shall be used for all non-ferrous tube joints to headers and connections. Ferrous to non-ferrous joints shall contain as much as 35% silver or may be Tobin bronze.
2. Gas shielded arc welding shall be used for all stainless steel joints and also for non-ferrous tube joints made to compatible or alike material headers and connections.

I. CASING

1. Coil casing and endplate shall be fabricated from Galvanized steel, as a standard construction, meeting ASTM and UL G90U requirements. Casing materials available shall include: aluminum, copper, carbon steel and stainless steel. All materials are available at different gauges. Double-flange casing shall be provided when coils are specified as vertical stacking.
2. Standard coil intermediate tube sheets (center tube supports) shall be fabricated from 16 gauge sheet stock and same material as the end plates, and to the following schedule:

Finned Length (inches)	Number of Tube Sheets
6.00 – 48.00	0
48.01 – 96.00	1
96.01 – 144.00	2
144.01 and greater	4

J. CERTIFICATIONS

1. Coil manufacturer shall be certified and registered with the Air Conditioning, Heating and Refrigeration Institute (AHRI) and shall be an active and current member of the AHRI Standard 410 Air-Cooling and Air-Heating Coils certification program and shall have original coil line certifications and computerized selections dating back a minimum of 30 years, as proof of overall company performance, stability and longevity. Manufacturers not capable of meeting this requirement shall be considered as unacceptable.

K. AGENCY APPROVAL Coil manufacturer shall be registered by UL to ISO 9000 (ANSI/ASQC Q92). Applicable commercial coil models shall be UL Standard 207 and registered as Refrigerant Containing Components and Accessories; non-electrical. CRN (Canadian Registration Numbers) shall be provided for all coils shipping into Canada as requested. Coil manufacturer shall also possess ASME Section VIII Division 1, U and UM stamping certification as proof of acceptable quality control methods. Manufacturers unable to meet the above listed agency approvals shall be considered as unacceptable.

2.38 ROOF EQUIPMENT AND PIPING SUPPORTS

A. Support Variable Refrigerant Flow (VRF) Heating Ventilation and Air Conditioning equipment on roof with an engineered system designed for installation without penetrating roof membrane. The engineered support system shall consist of injection

molded glass fiber filled nylon support feet, recycled rubber bound by polyurethane pre-polymer anti-vibration mat, hot dipped galvanized mild steel framework and fittings. System shall be factory designed to fit VRF equipment in service conditions.

B. Support piping on roof with an engineered system designed for installation without penetrating roof membrane. The engineered support system shall consist of injection molded glass fiber filled nylon support feet, recycled rubber bound by polyurethane pre-polymer anti-vibration mat, hot dipped galvanized mild steel framework and fittings. System shall be factory designed to fit equipment in service conditions.

C. Systems shall be Big Foot Systems from the RectorSeal Corp., Quicksling or equal.

D. General

1. Galvanized steel engineered framework support with injection molded glass fiber reinforced nylon foot assemblies with recycled rubber anti-vibration mats.
2. Material: Steel, nylon, rubber.
3. Finish: Hot Dip Galvanized.
4. Rail system shall be specifically design for the equipment it is supporting.

E. Support feet shall be mechanically attached to the structure.

1. Connection point shall be sealed weathertight.
2. Coordinate with Structural Contract for attachment points to structural support elements.

2.39 CONDENSATE PUMPS

A. Condensate pumps shall be fully automatic.

B. Basin shall be constructed of ABS plastic.

C. Volute and propeller shall be polypropylene.

D. Shaft shall be stainless steel.

E. Cover shall be ABS with 3 drain holes.

F. Unit shall be provided with a discharge check valve.

G. Thermal overload protection shall be provided.

H. Unit shall have a six foot power cord with plug.

I. Provide Blue Diamond or equal mini split style condensate pumps for all Mitsubishi wall cassette style units.

J. Provide condensate pumps where required by structure, where gravity drainage is not possible.

2.40 ELECTRIC UNIT HEATER

A. The electric ceiling heating panel shall be as manufactured by Berko (or equal).

B. The sizes, capacities and voltages shall be as per the schedules on the drawings.

C. Commercial grade construction and ceiling mounting brackets for horizontal or vertical flow mounting or any position in between.

D. Copper-brazed steel fins with steel sheathed tubular elements for uniform heating and longevity.

E. Adjustable louvers to control air throw direction.

2.41 ELECTRIC WALL HEATER

A. The electric fan powered wall heater shall be designed for recessed mounting and shall be as manufactured by Berko (or equal).

B. The heater shall be designed for surface or recessed wall mounting in any position. For surface mounting, a surface mounting box shall be used. For semi-recessed installation a semi-recessed sleeve shall be used.

C. The back box shall be designed for duty as a recessed rough-in box in either masonry or frame. The back box shall be 20-gauge cold rolled steel and shall contain knock outs through which field wiring leads are brought and connected to pigtails of the preinstalled female disconnect receptacle. Connecting of the male plug of the inner frame completes the wiring of the heater.

D. The inner frame assembly shall consist of a 20-gauge steel chassis on which are mounted the heating element, fan motor and blade, thermostat, fan control and thermal cut out. The inner frame assembly shall be completely prewired with the leads terminating in a male plug, thus facilitating positive disconnect and easy removal for service without disturbing the back box or field wiring.

E. The heating element shall be of nonglowing design consisting of a special resistance wire enclosed in a steel sheath to which steel plate fins are brazed. The element shall cover the entire air discharge area to ensure uniform heating of all discharge air.

F. The fan motor shall be impedance protected, permanently lubricated and with totally enclosed rotor.

G. Fan control shall be bimetallic, snap-action type and shall activate fan after heating element reaches operating temperature, and continue to operate the fan after the thermostat is satisfied and until all heated air has been discharged. The thermostat shall be of bimetallic, snap-action, two-pole type with enclosed contacts and with positive "off" on all models. Thermal cutout shall be bimetallic, snap-action type designed to automatically shut off heater in the event of overheating and reactivate the heater when temperatures return to normal.

H. The louvered front cover shall be of 20-gauge cold rolled steel finished in desert tan baked enamel or chrome finish, with four mounting holes, mounting screws, and plug button to match finish.

I. Unit shall be supplied with front covers without the hole for the thermostat knob to provide full tamper-proof installation.

J. All sheet metal parts, except chrome finished front covers, shall be phosphatized, then completely painted as determined by the architect by an electrostatic, baked enamel, painting process.

2.42 LOUVERS

A. General:

1. Furnish and install louvers, bird screens, blank-off panels, supports and mounting brackets. Refer to plans for sizes and quantities. Basis of design is Greenheck ESD-403 (or equal).

B. Frame:

1. Type: Channel
2. Frame Depth: 4 inches.
3. Material: Extruded aluminum, Alloy 6063-T5.
4. Wall Thickness: 0.063 inch, nominal.
5. Construction: Welded

C. Blades:

1. Style: Drainable.
2. Material: Formed aluminum, Alloy 6063-T5.
3. Wall Thickness: 0.063 inch, nominal.
4. Angle: 45 degrees.
5. Centers: 3 inches, nominal.

D. Gutters: Drain gutter in head frame and each blade.

E. Downspouts: Downspouts in jambs to drain water from louver for minimum water cascade from blade to blade.

F. Fabrication: Mullion/Hidden Intermediate Support Style – Design incorporates visible mullions or frames at the perimeter of the louver and at section joints only. Rear-mounted hidden blade supports are utilized where required and do not interrupt the louver blade sightlines. The rear-mounted blade support depth varies depending on louver height and the design wind load.

G. Factory assembled louver components. Mechanically fastened construction.

H. Performance Data:

1. Performance Ratings: AMCA licensed. Based on testing 48 inch by 48 inch size unit in accordance with AMCA 500.
2. Free Area: 37 percent, nominal.
3. Maximum Recommended Air Flow through Free Area: 800 feet per minute
4. Maximum Pressure Drop (Intake): 0.10 inches w.g.
5. Water Penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 1250 feet per minute free area velocity when tested for 15 minutes.

I. Finish

1. AAMA 2605 compliant coating
2. 3-Coat 70% Kynar (PVDF).
3. Color: By Architect

2.43 AIR CURTAIN

A. The unheated air curtain shall be manufactured by Powered Aire (Basis of Design), Mars Air Systems , Schwank or Berner International.

B. Motor Fan Assembly: Design for easy removal, assembly, repair, and maintenance.

1. Motor: Totally enclosed air over (TEAO) cooled motor with sealed lifetime pre-lubricated ball bearings, motor starter and thermal overload protection.
    a. Wired for single speed operation.
    b. Wired for two speed operation.
    c. Wired for three speed operation.
    d. Provide wash down type motors, NEC IP-54 for the locations indicated.
    e. Provide explosion proof type motors, NEC Class 1, Division 1, Group D for the locations indicated.
    f. Meets NEC. ETL Listed to conform to UL 507 (US) and CSA22.2 (Canada) Standards. AMCA 211 Certified.
    g. Electrical Characteristics: 115V AC, single phase; 5.1 Amp full load per motor/fan.

C. Fans: Forward curved centrifugal type, double width, and double inlet design, directly driven to an electric motor.
    1. Provide resilient isolation dampening mountings between motor frame and motor mounting pan.
    2. Factory balanced blower wheel assembly statically and dynamically.

D. Housing: Self-contained one-piece type for units up to 72 inches in length with sufficient strength for mounting from pre-punched mounting holes at both ends to ceiling without intermediate support. Units longer than 72” are two units tandem mounted next to each other
    1. Size:
        a. Unheated: 26 inches deep by 15-1/2 inches high by width of unit.
    2. Mounting:
        a. Unheated Inside Mount.
    3. Material:
        a. Provide T5052 20 gage aluminum conforming to ASTM B 209 and 20-gauge electro or hot dipped galvanized steel sheet housing conforming to ASTM A 591 and/or ASTM A 653.
    4. Air Inlet Grille and/or Filters: Provide air inlet grille and/or filters specified.
    5. Discharge: Provide integral discharge nozzle specified.
    6. Finish and Color: Provide with, no VOC, corrosion resistant polyurethane powder coated finish for sheet metal housings. Color selection by Architect.
        a. Pearl White.
        b. Obsidian Black.
        c. Titanium Silver.
        d. Stainless Steel.

E. Environmental Air Curtains: Internal mounted models for heights up to 12 feet (3658 mm) for Environmental Separation and Temperature Control and up to 10 feet (3048 mm) for Flying Insect Control.
    1. Discharge Nozzle: Adjustable air foil vanes with a plus/minus 40-degree sweep front to back.
    2. Air Velocity at Nozzle:

a. PH10 36-1: 36 Inch (915 mm) Wide Units: 1947 feet/min (9.9 m/s) single 1/2HP motor/fan assembly.
b. PH10 42-1: 42 Inch (1065 mm) Wide Units: 1806 feet/min (9.2 m/s) single 1/2HP motor/fan assembly.

F. Air Speed at Floor: Minimum of 400 fpm (2 m/s) at 3 feet (914 mm) from the floor.

G. Air Inlet Grille and Filters:

1. Location: Bottom/
   a. Filter: Cleanable polyester filter, 1 inch (25.4 mm).
2. Type: Fixed air intake grille
   a. Filter: Aluminum mesh, 1/4 inch (6.4 mm), washable.
3. Type: Filter Only as follows:
   a. Filter: Flat bank 1 inch, disposable.
   b. Filter: Aluminum mesh, 1/4 inch (6.4 mm), washable
4. Speed: 2550 cu ft/min (1200 L/s), minimum, per motor/fan assembly
5. Sound Pressure Level At 10 feet (3 m) From Nozzle:
   a. Single Motor/Fan Units: 66 dBA.
   b. Two Motor/Fan Units: 68 dBA.

H. Motor Control Panels for Unheated Units: Recommended for all three-phase units and single-phase units with combined motor capacities of more than 1 HP whenever a door limit switch is used to automatically start and stop the air curtain. Provide motor control panels as follows:

1. Mounting: Factory mounted on right hand side of air curtain housing.
2. Mounting: Factory mounted on left hand side of air curtain housing.
3. Electrical components UL/CUL listed.
4. Optional Digital Programmable Controller:
5. Remote Mounted High Resolution 5” Color LCD Display with Capacitive Touch technology
6. Fully programmable controller
7. Pre-set and fully customizable programs
8. Time delay (Passive & Adaptive)
9. 24/7 timer
10. Maintenance schedule alerts
11. Status display showing date, time, temperature, and air curtain mode
12. Multi-unit control capability
13. English (IP) or Metric (SI) display readings
14. Password protected
15. Auto Lock display
16. Emergency shut-off button
17. Low voltage control signal for door activation
18. Integrated BMS controls
19. VFD compatible with 0-10VDC output
20. Optional BACnet option

21. Optional adaptive fan speed control based on existing

I. Door-Activated Limit switch(s): Provide, field installed 250-Volts, 20 amps limit switch to control air curtain(s) as follows; Automatic on/off control, activates air curtain when door is opened and turns off when door is closed. Provide limit switch for direct control one 1 HP or up to two 1/2 HP single phase motors without a separate control panel. Provide a separate control panel for three-phase motors and/or units exceeding 1 HP, 250-Volts or 20 amps controlled by a limit switch.

1. Type: Combination plunger/roller switch for swing and sliding doors.
    a. Provide limit switches with NEMA 1 (20 amps) ratings in locations indicated.
2. Operation for Unheated Units: Automatic on/off control, on when door is opened, off when door is closed.

J. Provide mounting hardware as required for the opening.

2.44 DIRECT DIGITAL CONTROL SYSTEM

A. NOTE: CONTRACTOR IS REQUIRED TO PROVIDE ALL COMPONENTS, WIRING, LABOR, APPURTENANCES, AND COORDINATION SERVICES TO DELIVER A FULLY-FUCNTIONAL BUILDING AUTOMATION SYSTEM.

B. General

1. Automatic temperature control field monitoring and control system using field programmable micro-processor based units as an expansion of the existing city-wide building automation system.
2. The BAS contractor shall provide all interconnecting wiring, interfaces, and programming required to completely integrate any VRF or packaged HVAC systems into the building automation system and achieve full read / write capability of all system points from the BAS operator workstation as available at the system control workstation. The BAS contractor is responsible for achieving the specified sequences of operations.
3. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
4. Include computer software and all hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
5. Controls for variable refrigerant flow (VRF) system, packaged rooftop units, packaged unit ventilators, radiation, reheat coils, unit heaters, fan coils, blower coils, and the like when directly connected to the control units. Individual terminal unit control requirement is specified in its equipment section.
6. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment, power transformers and electrical feeds, and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
7. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

C. MANUFACTURERS

1. Honeywell International, Inc; Niagara/Tridium: www.honeywell.com/#sle.

2. Johnson Controls, Inc; Tridium Based FX-Series: www.johnsoncontrols.com/#sle.
3. KMC Controls; Niagara/Tridium: www.kmccontrols.com/#sle.
4. Substitutions: Not Permitted

D. CONTROLLERS

1. BUILDING LEVEL CONTROLLERS
    a. General:
        1 Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
        2 Provide sufficient memory to support controller's operating system, database, and programming requirements.
        3 Share data between networked controllers.
        4 Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
        5 Utilize real-time clock for scheduling.
        6 Continuously check processor status and memory circuits for abnormal operation.
        7 Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
        8 Communication with other network devices to be based on assigned protocol.
    b. Communication:
        1 Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
        2 Perform routing when connected to a network of custom application and application specific controllers.
        3 Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
    c. Anticipated Environmental Ambient Conditions:
        1 Outdoors and/or in Wet Ambient Conditions:
            a)Mount within waterproof enclosures.
            b)Rated for operation at 40 to 150 degrees F.
        2 Conditioned Space:
            a)Mount within dustproof enclosures.
            b)Rated for operation at 32 to 120 degrees F.
    d. Provisions for Serviceability:
        1 Diagnostic LEDs for power, communication, and processor.
        2 Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
    e. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
    f. Power and Noise Immunity:
        1 Maintain operation at 90 to 110 percent of nominal voltage rating.
        2 Perform orderly shutdown below 80 percent of nominal voltage.

3 Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

E. CUSTOM APPLICATION CONTROLLERS

1. General:
   a. Provide sufficient memory to support controller's operating system, database, and programming requirements.
   b. Share data between networked, microprocessor based controllers.
   c. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
   d. Utilize real-time clock for scheduling.
   e. Continuously check processor status and memory circuits for abnormal operation.
   f. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
   g. Communication with other network devices to be based on assigned protocol.
2. Communication:
   a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
   b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1 Mount within waterproof enclosures.
      2 Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1 Mount within dustproof enclosures.
      2 Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
   a. Diagnostic LED's for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for minimum of 72 hours.
6. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

F. APPLICATION SPECIFIC CONTROLLERS

1. General:
   a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.

b. Customized for operation within the confines of equipment served.
c. Communication with other network devices to be based on assigned protocol.

2. Communication:
   a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
   b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1 Mount within waterproof enclosures.
      2 Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1 Mount within dustproof enclosures.
      2 Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
   a. Diagnostic LEDs for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.

G. INPUT/OUTPUT INTERFACE

1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
2. All Input/Output Points:
   a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
   b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
3. Binary Inputs:
   a. Allow monitoring of On/Off signals from remote devices.
   b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
   c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Conform to all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
   a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or

resistance signals (thermistor, RTD).

b. Compatible with and field configurable to commonly available sensing devices.

6. Binary Outputs:
   a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
   b. Outputs provided with three position (On/Off/Auto) override switches.
   c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
   a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
   b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
   c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
   a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
   b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
      1 VAV or duct terminal units.
      2 Duct mounted heating coils.
      3 Zone dampers.
      4 Radiation.
   c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. System Object Capacity:
   a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
   b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

H. POWER SUPPLIES AND LINE FILTERING

1. Power Supplies:
   a. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
   b. Limit connected loads to 80 percent of rated capacity.
   c. Match DC power supply to current output and voltage requirements.
   d. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
   e. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.

f. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.

g. Operational Ambient Conditions: 32 to 120 degrees F.

h. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD 810 for shock and vibration.

i. Line voltage units UL recognized and CSA approved.

2. Power Line Filtering:

a. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.

b. Minimum surge protection attributes:

1 Dielectric strength of 1000 volts minimum.

2 Response time of 10 nanoseconds or less.

3 Transverse mode noise attenuation of 65 dB or greater.

4 Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

I. CONTROL UNITS

1. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.

2. Battery Backup: For minimum of 48 hours for complete system including RAM without interruption, with automatic battery charger.

3. Control Units Functions:

a. Monitor or control each input/output point.

b. Completely independent with hardware clock/calendar and software to maintain control independently.

c. Acquire, process, and transfer information to operator station or other control units on network.

d. Accept, process, and execute commands from other control unit's or devices or operator stations.

e. Access both data base and control functions simultaneously.

f. Record, evaluate, and report changes of state or value that occur among associated points. Continue to perform associated control functions regardless of status of network.

g. Perform in stand-alone mode:

1 Start/stop.

2 Duty cycling.

3 Automatic Temperature Control.

4 Demand control via a sliding window, predictive algorithm.

5 Event initiated control.

6 Calculated point.

7 Scanning and alarm processing.

8 Full direct digital control.

9 Trend logging.

10 Global communications.

11 Maintenance scheduling.

4. Global Communications:
    a. Broadcast point data onto network, making that information available to all other system control units.
    b. Transmit any or all input/output points onto network for use by other control units and utilize data from other control units.
5. Input/Output Capability:
    a. Discrete/digital input (contact status).
    b. Discrete/digital output.
    c. Analog input.
    d. Analog output.
    e. Pulse input (5 pulses/second).
    f. Pulse output (0-655 seconds in duration with 0.01 second resolution).
6. Monitor, control, or address data points. Mix shall include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs, as required. Install control unit's with minimum 30 percent spare capacity.
7. Point Scanning: Set scan or execution speed of each point to operator selected time from 1 to 250 seconds.
8. Upload/Download Capability: Download from or upload to operator station. Upload/Download time for entire control unit database maximum 10 seconds on hard wired LAN, or 60 seconds over voice grade phone lines.
9. Test Mode Operation: Place input/output points in test mode to allow testing and developing of control algorithms on line without disrupting field hardware and controlled environment. In test mode:
    a. Inhibit scanning and calculation of input points. Issue manual control to input points (set analog or digital input point to operator determined test value) from work station.
    b. Control output points but change only data base state or value; leave external field hardware unchanged.
    c. Enable control actions on output points but change only data base state or value.
10. Local display and adjustment panel: Portable control unit, containing digital display, and numerical keyboard. Display and adjust:
    a. Input/output point information and status.
    b. Controller set points.
    c. Controller tuning constants.
    d. Program execution times.
    e. High and low limit values.
    f. Limit differential.
    g. Set/display date and time.
    h. Control outputs connected to the network.
    i. Automatic control outputs.
    j. Perform control unit diagnostic testing.
    k. Points in "Test" mode.

J. LOCAL AREA NETWORK (LAN)

1. Provide communication between control units over local area network (LAN).
2. LAN Capacity: Not less than 100 stations or nodes.
3. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
4. LAN Data Speed: Minimum 19.2 Kb.
5. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
6. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
7. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

K. SYSTEM SOFTWARE

1. Operating System:
   a. Concurrent, multi-tasking capability.
      1 Common Software Applications Supported: Microsoft Excel.
   b. System Graphics:
      1 Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
      2 Animation displayed by shifting image files based on object status.
      3 Provide method for operator with password to perform the following:
        a)Move between, change size, and change location of graphic displays.
        b)Modify on-line.
        c)Add, delete, or change dynamic objects consisting of:
          (a) Analog and binary values.
          (b) Dynamic text.
          (c) Static text.
          (d) Animation files.
   c. Custom Graphics Generation Package:
      1 Create, modify, and save graphic files and visio format graphics in PCX formats.
      2 HTML graphics to support web browser compatible formats.
      3 Capture or convert graphics from AutoCAD.
   d. Standard HVAC Graphics Library:
      1 HVAC Equipment:
        a)Air Handlers.
        b)Terminal HVAC Units.
        c)Fan Coil Units.
        d)VRF Fan Coils.
        e)VRF Heat Pumps.

f) Energy Recovery Ventilators with Electric Duct Heating Coils.

g) Packaged Rooftop Units.

2 Ancillary Equipment:

a)Fans.

b)Pumps.

c)Coils.

d)Valves.

e)Piping.

f)Dampers.

g)Ductwork.

3 File Format Compatible with Graphics Generation Package Program.

L. Workstation System Applications:

1. Automatic System Database Save and Restore Functions:
   a. Current database copy of each Building Controller is automatically stored on hard disk.
   b. Automatic update occurs upon change in any system panel.
   c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
   a. Save database from any system panel.
   b. Clear a panel database.
   c. Initiate a download of a specified database to any system panel.
3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
4. On-line Help:
   a. Context-sensitive system assists operator in operation and editing.
   b. Available for all applications.
   c. Relevant screen data provided for particular screen display.
   d. Additional help available via hypertext.
5. Security:
   a. Operator log-on requires user name and password to view, edit, add, or delete data.
   b. System security selectable for each operator.
   c. System supervisor sets passwords and security levels for all other operators.
   d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
   e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
   f. All system security data stored in encrypted format.
6. System Diagnostics:
   a. Operations Automatically Monitored:

1. Workstations.
2. Printers.
3. Modems.

4. Network connections.
5. Building management panels.
6. Controllers.

b. Device failure is annunciated to the operator.

7. Alarm Processing:
   a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
   b. Configurable Objects:
      1. Alarm limits.
      2. Alarm limit differentials.
      3. States.
      4. Reactions for each object.
8. Alarm Messages:
   a. Descriptor: English language.
   b. Recognizable Features:
      1. Source.
      2. Location.
      3. Nature.
9. Configurable Alarm Reactions by Workstation and Time of Day:
   a. Logging.
   b. Printing.
   c. Starting programs.
   d. Displaying messages.
   e. Dialing out to remote locations.
   f. Paging.
   g. Providing audible annunciation.
   h. Displaying specific system graphics.
10. Custom Trend Logs:
   a. Definable for any data object in the system including interval, start time, and stop time.
   b. Trend Data:
      1. Sampled and stored on the building controller panel.
      2. Archivable on hard disk.
      3. Retrievable for use in reports, spreadsheets and standard database programs.
      4. Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
      5. Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.
11. Alarm and Event Log:
   a. View all system alarms and change of states from any system location.
   b. Events listed chronologically.

c. Operator with proper security acknowledges and clears alarms.
d. Alarms not cleared by operator are archived to the workstation hard disk.

12. Object, Property Status and Control:
    a. Provide a method to view, edit if applicable, the status of any object and property in the system.
    b. Status Available by the Following Methods:
        1 Menu.
        2 Graphics.
        3 Custom Programs.

13. Reports and Logs:
    a. Reporting Package:
        1 Allows operator to select, modify, or create reports.
        2 Definable as to data content, format, interval, and date.

14.

2.45 INSTRUMENTATION AND CONTROL DEVICES

A. General

1. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

B. Input/Output Sensors

1. Temperature Sensors:
   a. Sensor range shall provide a resolution of no worse than .4°F (unless noted otherwise).
   b. Room temperature sensor shall be an element contained within a ventilated cover, suitable for wall mounting with digital output. Sensors located in mechanical areas, plenums, garages, gymnasiums, or corridors shall be a flat plate sensor with no possible adjustment or shall be provided with aesthetically-pleasing lockable protective cover. Security screws shall be used in institutional settings as deemed necessary by the design engineer. ATC contractor shall coordinate requirements with the design engineer during the submittal process. Provide insulated base. Following sensing elements are acceptable:
      1 Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.
      2 Units shall be capable of +/- 2 degrees (F) adjustment by the occupant, with display showing current temperature and setpoint.
   c. Single point duct temperature sensor shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated in paragraph A. Sensor probe shall be 316 stainless steel.
      1 Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.
   d. Averaging duct temperature sensor shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide enough sensors to give one lineal foot of sensing element for each square foot of cooling coil face area. Temperature range as required for resolution indicated in paragraph A.
      1 Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.
   e. Liquid immersion temperature sensor shall include stainless steel thermowell, sensor and connection head for wiring connections.
      1 Sensing element for chilled water applications - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point. Temperature range shall be as required for resolution indicated in paragraph A.
      2 Sensing element for non-chilled water applications - Platinum RTD, +/- 0.2°F accuracy at calibration point. Temperature range shall be as required for resolution of no worse than 0.1°F.
2. Humidity Sensors:
   a. Elements: Accurate within 5 percent full range with linear output.
   b. Room Sensors: With locking cover , span of 10 to 60 percent relative humidity.

c. Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 – 100 percent relative humidity.

3. Building Static Pressure Transmitters:
   a. Manufacturers:
      1 Dwyer Instruments Inc; : www.dwyer-inst.com/#sle.
      2 Johnson Controls International, PLC; : www.johnsoncontrols.com/#sle.
      3 Setra Systems, Inc; : www.setra.com/#sle.
      4 Veris Industries; : www.veris.com/#sle.
      5 Substitutions: See Section 01 60 00 - Product Requirements.
   b. Single port for direct or tubing connection into wall or ceiling static pressure tip, direct acting, double bell, scale range 0.01 to 6.0 in-wc positive or negative, and sensitivity of 0.0005 in-wc. Transmit electronic signal to receiver with matching scale range.
4. Carbon Monoxide Sensors:
   a. Gas sensing module that holds fixed or replaceable carbon monoxide gas-sensor cartridge.
   b. Form Factor: IEC 60529, IP20 enclosure, single-gang electrical box mounted.
   c. Electromechanical sensor with 0 to 500 ppm measurement range.
   d. Accuracy: Plus/minus Five percent of range with 1 ppm resolution.
   e. Hardwired Output: Three-wire, 4 to 20 mA, loop powered.
   f. Alarm: Auxiliary dry contact relay driven by setpoint adjustable between 25 to 180 ppm.
5. Equipment Operation Sensors:
   a. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg.
   b. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

C. Thermostats
1. Line Voltage Thermostats:
   a. Integral manual On/Off/Auto selector switch, single or two pole as required.
   b. Dead band: Maximum 2 degrees F.
   c. Cover: Locking with set point adjustment, with thermometer.
   d. Rating: Motor load.
2. Outdoor Reset Thermostat:
   a. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
   b. Scale range: -10 to 70 degrees F.
3. Immersion Thermostat:
   a. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.
4. Airstream Thermostats:
   a. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.

b. Averaging service remote bulb element: 7.5 feet.

5. Electric Low Limit Duct Thermostat:
   a. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint,
   b. Bulb length: Minimum 20 feet.
   c. Provide one thermostat for every 20 sq ft of coil surface.
6. Electric High Limit Duct Thermostat:
   a. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above setpoint,
   b. Bulb length: Minimum 20 feet.
   c. Provide one thermostat for every 20 sq ft of coil surface.
7. Fire Thermostats:
   a. UL labeled, factory set in accordance with NFPA 90A.
   b. Normally closed contacts, manual reset.
8. Heating/Cooling Valve Top Thermostats:
   a. Proportional acting for proportional flow, molded rubber diaphragm, remote bulb liquid filled element, direct and reverse acting at differential pressure to 25 psig, cast housing with position indicator and adjusting knob.

2.46 SCAFFOLDS AND STAGING

A. General: Filed subcontractors shall obtain required permits for, and provide scaffolds, staging, and other similar raised platforms, required to access their Work as specified in Section 01 50 00 - Temporary Facilities and Controls and herein.

1. Scaffolding and staging required for use by this Filed subcontractor pursuant to requirements of Section 01 50 00 - Temporary Facilities and Controls shall be furnished, erected, maintained in a safe condition, and dismantled when no longer required, by this Filed Subcontract requiring such scaffolding.
2. Each Filed subcontractor is responsible to provide, maintain and remove at dismantling, all tarpaulins and similar protective measures necessary to cover scaffolding for inclement weather conditions other than those required to be provided, maintained and removed by the General Contractor pursuant to MGL (Refer to Section 01 50 00 - Temporary Facilities and Controls and as additionally required for dust control).
   a. General Contractor is responsible to provide enclosures required for temporary heat from November 1 to March 31; refer to Section 01 50 00 - Temporary Facilities and Controls.
3. Furnishing portable ladders and mobile platforms of all required heights, which may be necessary to perform the work of this trade, are the responsibility of this Filed subcontractor.

2.47 HOISTING MACHINERY AND EQUIPMENT

A. All hoisting equipment, rigging equipment, crane services and lift machinery required for the work by this Filed subcontractor shall be furnished, installed, operated and

maintained in safe conditions by this Filed subcontractor, as referenced under Section 01 50 00 - Temporary Facilities and Controls.

3 PART 3 - EXECUTION

3.1 WORKMANSHIP

A. All work shall be coordinated with the work to be installed by other sections of these specifications.

B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.

C. All duct supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.

D. Nameplates, catalog numbers, and rating identifications shall be securely attached to equipment.

E. The work shall be performed in a timely manner so as to cause no delay in the overall job progress. The HVAC Sub-Contractor shall cooperate with the other trades so that the work is installed in the most beneficial sequence for expeditious project completion.

3.2 CLEANING OF SYSTEMS AND PREMISES

A. Before the systems are tested and balanced, all ducts serving the area under construction shall be cleaned so that no dirt, dust or other foreign matter will be carried through or deposited in the systems or the space served by the duct systems.

B. At all times keep the premises clear of rubbish.

C. Upon completion of the work in an area, remove all debris and rubbish resulting from the execution of this contract, and dispose of same. At any time should the General Contractor be dissatisfied with the performance of the HVAC Sub-Contractor's clean up responsibilities, he may elect after notifying the HVAC Sub-Contractor to undertake this operation and to backcharge the HVAC Sub-Contractor accordingly.

3.3 HVAC SUB-CONTRACTOR'S WARRANTY

A. The HVAC Sub-Contractor shall provide a one year warranty against failure of the installed materials for any reason. The warranty shall cover the full costs of parts and labor required to remedy the defect, including, if necessary, replacement at the site, and shall run from the date of the Architect's acceptance of the system. The warranty shall also include provision for field inspection at no charge to the Owner, to verify failure, establish probable cause, and determine corrective action required. The HVAC Sub-Contractor shall furnish all service during the first year of operation. Any material, that in the opinion of the architect, requires excessive service during the first year of operation shall be considered defective and will be replaced by the HVAC Sub-Contractor at no charge to the Owner.

B. The HVAC Sub-Contractor shall provide a listing of all manufacturers’ commercial warranties provided by those manufacturers on their Materials. The list of these warranties must include the time period of each warranty. One copy each of those warranties shall be submitted with the listing.

C. The HVAC Sub-Contractor shall be responsible for warranting the testing, adjusting and balancing work for a period of one year after final date of completion. The HVAC Sub-Contractor shall also be responsible for all damage to existing systems as a result of the work performed. All damaged systems shall be repaired or replaced at the option of the Owner at no additional cost to the Owner. All such repair or replacement work shall be done immediately upon finding.

D. Warranty response to any malfunction shall be on a next day, normal working hour basis.

E. Work under warranty shall be performed by fully qualified workmen and/or technicians.

F. All guarantees and warranties required to be provided for the work in this Section shall begin their term on the date of final written acceptance of the entire system by the Owner.

3.4 SUBMITTALS

A. The capacity of each HVAC unit shall be substantiated by computer generated selection data or other detailed selection data provided by the manufacturer, for the specific conditions defined on the drawings.

1. The selection data shall clearly show the entering and leaving fluid conditions, the fluid flow volume and the fluid pressure drop through the unit, the ambient conditions, the heat rejection media entering and leaving conditions, the available external static pressure, the unit total static pressure, the airside pressure drops, the refrigerant and the saturated suction temperature, the required RPM of the unit, the motor horsepower, the motor voltage, the motor efficiency, the motor RPM, the motor type, the fuel efficiency, the fuel consumption rate, the maximum capacity, the part load performance data of the anticipated operation of the system, and the radiated sound ratings at design conditions as may be appropriate for any specific piece of equipment.

B. HVAC Sub-Contractor shall submit shop drawings indicating the method of supporting all units.

3.5 PERFORMANCE

A. The drawings are diagrammatic and the final arrangement of the work shall suit the existing and field conditions, the characteristics of the materials used and the instructions of the Engineer and/or the Architect.

B. The HVAC Sub-Contractor shall be responsible for repair of damaged or disturbed existing work or the work of other trades caused by his work, testing of his work or repair to his work.

C. All devices shall be installed in accordance with the manufacturer's recommendations, the Engineer's instructions and so as to provide all required access for cleaning, operation, repair and maintenance.

3.6 START UP

A. All equipment, systems, controls and units shall be started as part of a heating, ventilating and air conditioning system, in accordance with all manufacturers’ recommendations.

B. Copies of startup sheets shall be included in Operations & Maintenance Manuals.

3.7 VIBRATION ISOLATION

A. All equipment, piping, etc. shall be mounted on or suspended from approved foundations and supports, as specified herein or as shown on the drawings.

B. Mounting sizes shall be determined by the mounting manufacturer and the mountings shall be installed in accordance with the manufacturer's recommendations. The HVAC Sub-Contractor shall be responsible for the adequacy of the mountings to provide the minimum isolation efficiency required by these specifications or as specifically noted on the drawings.

C. Suspended centrifugal fans shall be installed on vibration isolation hangers.

3.8 RECTANGULAR DUCTS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Sheet Metal Sub-Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

B. Sealing

1. All ductwork shall be sealed in accordance with the following table:

SMACNA SEAL CLASS	SEALING REQUIRED	SMACNA STATIC PRESSURE CONSTRUCTION CLASS
A	All transverse joints All longitudinal seams All duct wall penetrations	4” W.G. and up
B	All transverse joints All longitudinal seams	3” W.G.
C	All transverse joints	2” W.G. and down

2. For the purposes of these specifications sealing shall mean the following:
   a. The use of adhesives, gaskets, liquids, mastics, hot melt sealant, pressure sensitive tape or combinations thereof to close openings in the surface of the ductwork and field erected plenums and casings through which air leakage would occur.
   b. The requirements to seal apply to both positive and negative pressure modes.
3. Pressure sensitive tape shall only be acceptable for sealing ductwork which operates at a static pressure of ½" or less.
4. Liquid sealant shall only be acceptable for slip joints where metal clearances do not exceed 1/16".
5. Gaskets shall be used for all flanged connections and shall have an adhesive backing to adhere to the flange during assembly of the joint.

C. Reinforcement

1. Unless specified otherwise on the drawings rectangular ductwork shall be constructed and reinforced per the following "Rectangular Duct Reinforcement" tables, where the duct wall thickness, the reinforcement spacing and the rigidity class are specified by duct size and pressure classification. Rigidity class designations are based on the SMACNA standards for "Intermediate Reinforcement" and "Transverse Joint Reinforcement" as published in the SMACNA "HVAC DUCT CONSTRUCTION STANDARDS - Metal and Flexible".
2. Duct sides that are 19" and over and are 20 gauge or less with more than 10 square feet of unbraced panel shall be cross broken or beaded unless they are lined or externally insulated.
3. Fittings shall be reinforced similarly to sections of straight duct. On size change fittings the greater fitting dimension determines the duct gauge. Where fitting curvature or internal members provide equivalent rigidity, such features may be credited as reinforcement.
4. The duct side with the largest dimension shall determine the duct gauge.
5. Holes made in the duct walls for the passage of tie rods shall be of minimum size and shall be sealed in accordance with the required duct seal classification.
6. Where used tie rods shall be evenly spaced in the width of the duct dimension.

D. Transverse Joints

1. Transverse joints shall be selected and used consistent with the static pressure class, sealing requirements and duct support intervals for proper assembly.
2. Where bar or angle stock is incorporated in a joint it shall be secured.
3. Fasteners shall be steel and may be zinc or cadmium coated. They shall not project into duct more than ½".
4. Where bolts or welds are specified other types of fasteners shall not be used.

E. Seams

1. Seams shall be suitably selected for the material and pressure classification of the duct.
2. Seams shall be formed and assembled with proper dimension and proportion for tight and secure fit.

3.9 RECTANGULAR DUCT FITTINGS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Sheet Metal Sub-Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

3.10 ROUND DUCTS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.

2. The Sheet Metal Sub-Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

B. Duct Gauge

1. Round ducts shall be constructed of the galvanized steel with duct walls in accordance with ”SMACNA” standards.

3.11 ROUND DUCT FITTINGS

A. Elbows larger than 8" shall be five piece welded construction.

B. Branch and take-off fittings shall be conical tee or conical reducing tee fittings.

C. Final connections to the individual terminal supply units shall be by means of flexible duct.

3.12 BALANCING DAMPERS

A. Balancing dampers shall be located as shown on the drawings and in the following locations as a minimum:

1. All supply and return air branches from the trunks and all sub-branches from the mains shall have balancing dampers.
2. Branch duct connections from low pressure ducts to diffusers shall be made with dampered spin collars.

B. Locate dampers as far as possible from air outlets.

3.13 FLEXIBLE DUCTS

A. Use

1. Flexible ducts shall not exceed 5 feet in length.
2. All flexible duct used on the supply air system shall be insulated with 1½" thick vinyl jacketed fiberglass insulation.

B. Length

1. The minimum length of flexible duct shall be used.
2. The maximum length of flexible duct in any single duct run shall be four feet.
3. Flexible duct shall not be used on supply air systems.

C. Bends

1. Bends shall be made with not less than one and one half duct diameter centerline radius.
2. Maximum bend shall be 90°.

D. Fastening

1. Secure flexible duct to collar or sleeve by peeling back jacket and insulation at end of flexible duct. Fit duct over collar or sleeve and clamp with ½" wide galvanized steel or stainless steel bands or clamps and matching seals. Pull jacket and insulation back in place and secure with two wraps of pressure sensitive sealing tape. Clamping device shall be two inches back from end of flexible duct. Seal with two wraps of duct tape.

E. Installation

1. Flexible duct is to be installed as straight as possible and as tight as possible.
2. Submittals shall include product data sheets as well as the manufacturer's recommended installation practices.

3.14 SUSPENSION OF DUCTWORK

A. Rigid round and rectangular ducts shall be installed with support systems as required to maintain alignment. Horizontal ducts shall have a support within two feet of each elbow and within four feet of each branch intersection.

B. Strap hangers on rectangular ducts may be used on ducts less than 60" wide if they are secured to the bottom of the duct with an approved fastener and with a minimum 1" tab below the duct, or with no fasteners if the strap is a single continuous loop.

C. Multiple trapeze hangers may be suspended from rod hangers to support ducts directly above and below each other if the rods are sized to support the combined load.

D. Round ducts less than 10" in diameter may be suspended by wire.

E. All hangers and trapezes shall be sized, spaced and selected in accordance with Section IV of SMACNA "HVAC DUCT CONSTRUCTION STANDARDS".

3.15 MISCELLANEOUS DUCT WORK REQUIREMENTS

A. Ductwork connected to intake or discharge louvers shall be painted inside for the first ten feet with bitumastic and pitched to a low point. The low point is to be provided with a 1½" copper drain piped by this trade to a building drain.

B. A gasket type joint shall be used where dissimilar metals are joined.

3.16 DUCT INSULATION - DUCT WRAP

A. All work shall be in strict accordance with applicable codes and ordinances and the manufacturers recommendations.

B. All completed work shall be smooth in appearance.

C. Seams shall be stapled 6" on center with outward clinching staples and sealed with pressure sensitive aluminum foil tape.

D. All seams, joints punctures and tears shall be sealed with pressure sensitive aluminum, foil tape.

E. All make-up air ductwork, air conditioning supply ductwork, and ductwork connected to SF-1 shall be insulated. All exterior insulated ductwork shall be weather proofed per Section 2.7.

3.17 PIPE HANGERS, SUPPORTS, ANCHORS AND GUIDES

A. The HVAC Sub-Contractor shall submit shop drawings indicating the method of supporting all piping furnished by this trade.

B. The Structural Engineer or Architect must approve the method of hanging before work is commenced.

C. Shop drawings of anchors shall be submitted before work is commenced.

D. Shop drawings of guides shall be submitted before work is commenced.

E. Sleeves of the specified type shall be installed wherever pipe lines penetrate walls, roofs, floors or partitions.

F. Sleeves shall be installed in accordance with the requirements of NFPA and the Massachusetts State Building Code.

3.18 PIPING SYSTEM INSTALLATION AND ASSEMBLY

A. All piping shall be installed at right angles to building surfaces, supports and structures.

B. Pipe welding shall performed by a certified welder with oxy-acetylene or electric arc in accordance with the latest revision of the applicable code, ASME Boiler Construction Code, ASA Code for Pressure Piping, or state and/or local codes which may supersede codes mentioned.

C. Threaded joints shall be made with Teflon tape only applied to male threads and care being taken to insure that the tape does not reach the interior of the pipe. All burrs and/or cuttings shall be removed and the pipe shall be reamed or filed out to not less than the original diameter. Piping shall be kept free from scale and dirt.

D. All pipes shall be straight, true and round without obstructions and with sharp, full cut threads or with ends beveled for welding.

E. Provide drain valves with hose connections at all low points and at the bottoms of all risers to allow for complete drainage of the system.

F. All openings shall be capped or plugged during construction to prevent dirt and/or rubbish from entering the piping.

G. Unions or flanged connections shall be placed wherever necessary to permit easy dismantling of the piping and equipment.

H. Where possible, piping shall be grouped together and supported in a neat and orderly manner.

I. Insulating bushings or dielectric nipples shall be provided between steel piping and copper piping on equipment.

J. Air vents shall be provided where indicated on the drawings and at all high points in the water systems.

K. Pipe must be supported before and after expansion compensation devices.

L. Mount all pressure gauges to be read from the floor.

M. Install pressure gauges on the suction and discharge of pumps.

N. Provide two spare pressure gauges of each pressure range and type.

O. Mount all thermometers to be read from the floor.

P. Install thermometers on the supply and return of the chill water system.

Q. Provide two spare thermometers of each range and type.

3.19 SEISMIC RESTRAINTS

A. Seismic restraints shall be provided in accordance with 780 CMR 1612.0 EARTHQUAKE LOADS. This specification does not require any additional seismic restraints beyond those of 780 CMR.

B. Seismic restraints are required for:

1. The energy recovery ventilator.
2. Make Up Air Unit

C. The HVAC Sub-Contractor shall be responsible for the design of the seismic restraints. The HVAC Sub-Contractor shall have the seismic restraint shop drawings stamped by a registered structural engineer.

3.20 VRF SYSTEM

A. General

1. The installing contractor shall have been certified by the manufacturer to install VRF systems, having attended a minimum 3- day VRF Service & Installation course at an authorized training center. A copy of this certificate shall be presented as part of the VRF equipment submittal process
2. Upon completion of the Equipment Start-Up, the VRF manufacture or VRF representative shall provide a formal report outlining the status of the system, in electronic format only. Contained within this report shall be a close-out letter, manufacturer's design software as-built file, and all recorded system information.

B. Pre Start-Up Inspection

1. Contractor shall employ the services of the VRF manufacturer or representative whose primary job responsibilities are to provide direct technical support of VRF products; sales staff or in-house support staff are not permitted to complete this scope of work, to provide a comprehensive physical startup of equipment. The following shall be completed prior to the startup of equipment:
2. The installing contractor shall provide a copy of the as-built electronic design file used in the installation of the system being inspected. This electronic design file shall have been completed on software approved by the specified VRF manufacture and shall have been updated to reflect as-built conditions.
3. Prior to start-up, all systems components shall be in a final state of readiness having been fully installed and awaiting start-up. Manufacturer's pre-startup checklist shall be completed and provided to engineer.
4. The installing contractor shall have prepared the refrigeration piping systems per equipment installation and service manuals. All refrigerant piping systems, upon completion of assembly, shall have been pressurized to a minimum 600 PSI, using dry nitrogen, and held for a consecutive 24HR period. A record of the pressure check process shall be recorded and tagged at the outdoor unit. The tag shall contain information for two events: start & stop. Each event shall include: date, time, fill pressure, outdoor temperature, and the person's full name completing each task.
5. Upon completion of the 600 PSI pressure check, the system shall be evacuated to a level of 500 microns, where it will be held for a period of 1HR with no deflection.

The installing contractor shall utilize the triple evacuation method per the equipment install and service manuals. Evacuation start & stop dates, times, and persons involved shall be recorded and tagged at the outdoor equipment.

6. Upon the completion of the 500 micron hold, the calculated additional refrigerant charge can be added. The calculated refrigerant charge shall have been calculated using the manufactures design software. Total refrigerant charge of the system shall be recorded and displayed at the outdoor unit by permanent means.
7. A review of the equipment settings shall be completed, with recommendations provided to improve system performance, if applicable. Physical changes of system settings will be completed by the contractor.
8. All pressure check and evacuation tags shall be reviewed by the Mechanical Engineer before physical start-up begins.
9. Engineer must be notified (1) week before physical system start-up date. Manufacturer's pre start-up checklist must be provided with this notification.

C. Physical Start-Up of Equipment

1. Upon proper equipment start up by the contractor, following the manufacturer's guidelines and specifications, The representative shall complete a review of the system performance and complete the following tasks:
   a. Check and confirm all communication addressing of system components.
   b. Check and confirm each indoor unit, individually, is properly piped and wired by commanding the indoor unit on, in either heat or cool mode.
   c. Electronically record a minimum of one-hour of operational data per refrigeration system.
   d. Electronically record dip switch positions on all indoor and outdoor equipment.

D. VRF Equipment Warranty

1. Contractor is responsible for successfully completing the Start-Up & Extended Warranty processes and fulfilling all requirements, as outlined by the manufacturer. The equipment shall be provided with the following warranty period:
   a. Compressor: 10-year
   b. Parts: 10-years

E. Close-Out Information

1. The Manufacturer or VRF representative shall issue a system close out document at the completion of all field work. Contained within this report shall be an overview of the system performance, recommendations, all electronic data, and as-built design file.
2. Contractor shall submit proof of extended warranty registration.

F. Owner Turnover

1. The VRF manufacturer or representative shall provide the owner's representative a minimum [4]-hour operation and maintenance training class covering systems installed under this scope of work. Training is to be provided at the time of owner occupancy.

3.21 ENERGY RECOVERY VENTILATORS

A. Examination

1. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
2. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.
3. Proceed with installation only after all unsatisfactory conditions have been corrected.

B. Installation

1. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

C. Connections

1. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
2. Piping installation requirements are specified in Division 22 (Plumbing). Drawings indicate general arrangement of piping, fittings and specialties.
3. Duct installation and connection requirements are specified in Division 23 of this document.
4. Electrical installation requirements are specified in Division 26 of this document.

D. Field Quality Control

1. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A / E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

E. Start-up Service

1. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

F. Demonstration and Training

1. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit.

3.22 AUTOMATIC TEMPERATURE CONTROLS

A. Installation Standards

1. Comply with BICSI TCI, TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3, and TIA/EIA-569-A.

B. TAB Support

1. Pre-TAB Meeting: Approximately 2 weeks prior to the initiation of Division 23 "Testing, Adjusting and Balancing for HVAC" services on site, schedule a meeting giving notice to the Construction Manager, Architect and Engineer and facilities representative(s).
   a. Publish an agenda with a minimum of the following discussion items:

1 “Instrumentation and Controls for HVAC" sequence of upcoming construction.
2 "Testing, Adjusting and Balancing for HVAC" sequence of upcoming construction.
3 TAB for support from "Instrumentation and Controls for HVAC."
4 "Instrumentation and Controls for HVAC" requirements for support from TAB.
5 Timing, support and documentation procedures.
6 Operation, diversities and setpoints of systems and equipment.

b. Division 23 "Testing, Adjusting and Balancing for HVAC" shall fully support Division 23 "Instrumentation and Controls for HVAC" in the testing and calibration of all devices with fluid flow, motor transformers, static pressures and the like and shall coordinate work so as to not interfere with instrumentation and controls installation and setup activities.
c. Division 23 "Instrumentation and Controls for HVAC" shall fully support Division 23 "Testing, Adjusting and Balancing for HVAC" in the operation, start and stop of all systems as well as the setting of values required for proper balancing and shall coordinate work so as to not interfere with TAB activities.

C. Construction/Commissioning Access Account

1. Individual read/view only web based access accounts shall be provided to the Engineer and to the Commissioning Agent. Account shall be set up once on-site server/workstation is active and pertinent access username, password, information and instructions shall be emailed to the Engineer and to the Commissioning Agent as early in the project as possible. Minimum read/view only access shall be provided to the following:
   a. Graphics.
   b. Programming.
   c. Trend Data.
   d. Alarms.

D. Examination

1. Verify that power supply is available for control units and operator workstation.
2. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.
3. Examine pathway elements intended for cables.
   a. Verify proposed routes of pathways. Check raceways, cable trays, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with EMI clearance requirements.
   b. Prepare wall penetrations and verify that penetrations of rated fire walls are made using products labeled for type of wall penetrated.
   c. Identify plan to support cables and raceways in suspended ceilings. Verify weight of individual types and sizes of cables. Verify that load capacity of cable support structures is adequate for each pathway.
   d. Proceed with installation only after unsatisfactory conditions have been

corrected.

E. Installation

1. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
2. Connect and configure equipment and software to achieve sequence of operation specified.
3. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 60 inches above the floor.
   a. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
4. Install guards on thermostats, if the functionality cannot be disabled, in the following locations
   a. Entrances.
   b. Public areas.
   c. Where indicated.
5. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
6. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
7. Install labels and nameplates to identify control components according to Division 23 requirements.
8. Install refrigerant instrument wells, valves, and other accessories according to Division 23 requirements.
9. Install duct volume-control dampers according to Division 23 requirements.
10. Install electronic and fiber-optic cables according to Division 27 Section requirements.

F. Application of Media

1. Backbone Cable for Data Service: Use UTP Category 6 for runs between cabinets.
2. Horizontal Cable for Data Service: Use UTP Category 5e cable for runs between cabinets and peripheral equipment.

G. Electrical Wiring And Connection Installation

1. Comply with NECA 1.
2. Wiring Method: Install wiring and optical fiber in raceway within the following areas: mechanical rooms, electrical rooms, exposed areas, within walls and above inaccessible ceilings. Conceal raceway except in mechanical rooms and areas where other raceway and piping are exposed.
3. Wiring Method: Install wiring and optical fiber in raceway except consoles, cabinets, desks, and counters, and except in accessible ceiling spaces where unenclosed wiring method may be used for systems that are not part of life safety systems, including but not limited to, smoke exhaust systems, stair pressurization systems, smoke control systems, or hazardous exhaust systems, or systems on emergency/standby power, or main communications systems cable. Use UL listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in mechanical rooms and areas where other raceway and piping are exposed.
4. Cable Installation:

a. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
b. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.
c. Pulling Cable: Do not exceed manufacturer's written recommended pulling tensions. 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.
d. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
e. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
f. Install UTP cables using techniques, practices, and methods that are consistent with Category 5e or 6 rating of components and that ensure Category 5e or 6 performance of completed and linked signal paths, end to end.
    1 Do not untwist more than 1/2 inch of Categories 5e and 6 cables at connector terminations.

5. Separation from EMI Sources: Comply with BICSI TDM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment. Comply with the following minimum separation distances from possible sources of EMI:
    a. Separation between unshielded power lines or electrical equipment in proximity to open cables or cables in nonmetallic raceways is as follows:
        1 Electrical Equipment Rating Less Than 2 kVA: 5 inches.
        2 Electrical Equipment Rating Between 2 and 5 kVA: 12 inches.
        3 Electrical Equipment Rating More Than 5 kVA: 24 inches.
    b. Separation between unshielded power lines or electrical equipment in proximity to cables in grounded metallic raceways is as follows:
        1 Electrical Equipment Rating Less Than 2 kVA: 2-1/2 inches.
        2 Electrical Equipment Rating Between 2 and 5 kVA: 6 inches.
        3 Electrical Equipment Rating More Than 5 kVA: 12 inches.
    c. Separation between power lines and electrical equipment located in grounded metallic conduits or enclosures in proximity to cables in grounded metallic raceways is as follows:
        1 Electrical Equipment Rating Less Than 2 kVA: No requirement.
        2 Electrical Equipment Rating Between 2 and 5 kVA: 3 inches.
        3 Electrical Equipment Rating More Than 5 kVA: 6 inches.
    d. Electrical Motors and Transformers, 5 kVA or HP and Larger: 48 inches.
    e. Fluorescent Fixtures: 5 inches.
6. Conduit:
    a. Comply with TIA/EIA-569-A for maximum length of conduit and bends between pull points, and for pull-box sizing.
    b. Use manufactured conduit sweeps and long-radius ells whenever possible.
    c. In mechanical rooms, position conduit ends adjacent to a corner on backboard (in

case of a single piece of plywood) or in the corner of room (where multiple sheets of plywood are installed around perimeter walls of room). Use cable trays to route cables if conduits cannot be located in these positions. Secure conduits to backboard when entering room from overhead. Extend conduits 1 to 3 inches in finished floor.

d. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
e. Install exposed cable in raceway.
f. Install concealed cable in raceway.
g. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
h. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
i. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
j. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

7. Install raceways, boxes, and cabinets according to Division 26 requirements.
8. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
9. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

H. Grounding

1. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems" and with TIA/EIA 607.
2. Grounding Points:
   a. Locate grounding terminals in each equipment room, wiring closet, rack, and cabinet.
   b. Telecommunications Grounding Busbars: Mount on wall of equipment room and closet, with standoff insulators.

I. Bonding Conductors:

1. Extend from telecommunications entrance facility to grounding busbars.
2. Extend from grounding busbars to ground terminals in cabinets.

J. Special Requirements:

1. Bonding conductors shall be insulated copper, No. 6 AWG minimum.
2. Install only in nonmetallic conduit, unless specifically required for protection of conductor. Metallic conduit, if used, shall be RMC. For RMC that exceeds 36 inches in length, conductors shall be bonded at each end of conduit.
3. Bonding conductors shall be installed without splices unless approved by Architect because of special circumstances. Where splices are necessary, they shall be accessible and shall be located in telecommunications spaces. Splices shall be by irreversible compression connectors or by exothermic welding.

K. Field Quality Control

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
2. Perform the following field tests and inspections and prepare test reports:
    a. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
    b. Test and adjust controls and safeties.
    c. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
    d. Test each point through its full operating range to verify that safety and operating control set points are as required.
    e. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
    f. Test each system for compliance with sequence of operation.
    g. Test software and hardware interlocks.
3. DDC Verification:
    a. Verify that instruments are installed before calibration, testing, and loop or leak checks.
    b. Check instruments for proper location and accessibility.
    c. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
    d. Check instrument tubing for proper fittings, slope, material, and support.
    e. Check installation of air supply for each instrument.
    f. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
    g. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
    h. Check temperature instruments and material and length of sensing elements.
    i. Check control valves. Verify that they are in correct direction.
    j. Check DDC system as follows:
        1 Verify that DDC controller power supply is from emergency power supply, if applicable.
        2 Verify that wires at control panels are tagged with their service designation and approved tagging system.
        3 Verify that spare I/O capacity has been provided.
        4 Verify that DDC controllers are protected from power supply surges.
4. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.
5. In addition to requirements in this Article, comply with TIA/EIA-606-A and with applicable requirements in Division 26 requirements.
    a. Administration class for this Project shall be Class 2 or 3.
    b. Color-code cross-connect fields. Apply colors to service backboards, connections, covers, and labels.

6. Using cable and asset management software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable, jacks, connectors, and terminals to which it connects with same designation. Use logical and systematic designations for facility's architectural arrangement. At completion, cable and asset management software shall reflect as-built conditions.
7. Use logical and systematic designations for facility's architectural arrangement and nomenclature, and a consistent color-coded identification of individual conductors.
8. Cable and Wire Identification:
    a. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
    b. Label each terminal strip and screw terminal in each cabinet.
        1 All wiring conductors connected to terminal strips shall be individually numbered, and 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.
        2 Label each unit and field within distribution racks and frames.
9. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

L. GRAPHICS ORGANIZATION

1. General:
    a. Graphics shall be full color with motion utilizing floor plans wherever possible to indicate location of applicable information and fully accessible through the web-based software.
    b. A general color scheme shall be utilized to indicate status of equipment and information.
        1 BLUE: Equipment/system normal, off; point normal.
        2 GREEN: Equipment/system normal, on.
        3 YELLOW: Equipment/system alarm, operating; point minor alarm.
        4 RED: Equipment failure; point major alarm.
        5 PURPLE: Operator override.
    c. Provide the following links in a block in the same general location on every graphic:
        1 Primary graphic.
        2 All screens associated with the current graphic.
        3 As-Built Sequence of Operation
        4 Back to previous.
        5 Forward to next.
    d. Organize graphics in easily understandable levels to minimize search time for desired information.
        1 There shall be at least 2 levels and no more than 4 levels.
        2 Smaller systems can have one primary graphic with links to all other

graphics.

3 Larger systems can be organized with one primary graphic, a secondary set of categorized graphics to organize like specific graphics (i.e., zones, air systems, chilled water systems, hot water systems, etc.), then a third layer to take the user to specific graphics.

2. Primary Graphic:
   a. The primary graphic will show well organized links to all other graphic levels with short descriptive labels.
   b. Import the Owner's logo and clearly show the project name.
3. Zone Graphics:
   a. Provide floor plan based graphics to show zones. Organize in a similar fashion to Contract Drawings and provide a sufficient scale so all information is easily readable and understandable.
   b. Provide links to all other zone graphics.
   c. Provide links to all individual zone terminal equipment.
   d. Show all zone terminal equipment information with blocks in the associated zone. Each block shall change color to indicate normal/alarm modes.
4. System Graphics:
   a. Each discreet system shall have a single graphic organized in schematic form accurately representing the installation configuration.
   b. Each system or piece of equipment that has been provided with 2-way communications such as through an RS 485 connection shall be provided with a dedicated graphic regardless of which contract it was provided under or if it was Owner/tenant provided.
   c. Provide links to all associated graphics (i.e., AHU to other AHU's and to exhaust systems, chilled water system to cooling tower system and hot water system).
   d. Locate pertinent information next to its associated graphic representation.
   e. Provide a link to a separate page that displays the system as-built sequence of operation.
5. Monitoring Graphics:
   a. Where equipment is monitored for specific information and no 2-way communication is available, it may be grouped on a floor plan or multiple plans.
6. Energy Usage Graphics:
   a. Provide separate graphics pages for the ongoing accountability of building energy usage and consumption over time. Building energy usage graphics shall be provided with hyperlinks to the main building graphics homepage to facilitate "user friendly" operations.
   b. Provide dynamic historical trending and totalization of each piece of equipment (energy use of each component). Totalize data for the continuous monitoring of metering equipment for constant and variable motor loads, VFD operation, cooling loads, AHU energy usage (air-side), air and water-side economizers, air distribution static pressure and air ventilation volumes.
   c. Monitor electrical system power and lighting system power consumption through each switchboard circuit breaker connection. Provide dynamic historical trending and totalization of each circuit.

d. Coordinate data (run-time hours, electrical consumption, kW hours, kW/ton, kWH/year, $savings/year, etc.) with building energy model and the Commissioning Agent.

7. Show the block in its general location with an equipment label and normal and alarm color changing.
8. Custom Graphics: Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in industry standard formats such as PCX, TIFF, and GEM. The graphics generation package also shall provide the capability of capturing or converting graphics from other programs such as Designer or AutoCAD.
9. Graphics Library: Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

M. Programming

1. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.
2. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index. Use the following naming convention: AA.BBB.CCDDE where AA is used to designate the location of the point within the building, such as mechanical room, wing, or level, or the building itself in a multi-building environment, BBB is used to designate the mechanical system with which the point is associated (e.g., A01, HTG, CLG, LTG), CC represents the equipment or material referenced (e.g., SF for supply fan, RW for return water, EA for exhaust air, ZN for zone), D or DD may be used for clarification or for identification if more than one CC exists (e.g., SF10, ZNB), E represents the action or state of the equipment or medium (e.g., T for temperature, H for humidity, C for control, S for status, D for damper control, I for current).
3. Software Programming:
   a. Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
      1 Text-based:
      2 Organized in single purpose blocks of programming.
      3 Must provide actions for all possible situations.
      4 Must be modular and structured.
      5 Must be commented with a description and purpose.
   b. Graphic-based:
      1 Organized in single purpose functional blocks.
      2 Must provide actions for all possible situations.

3 Organize blocks in a neat flowing structure.

4 Blocks must be annotated with a description and purpose in a text block.

5 Must be documented.

4. Operator Interface:

a. Standard Graphics: Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as set points.

b. Show terminal equipment information on a "graphic" summary table. Provide dynamic information for each point shown.

c. The Contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this Section. This includes any operating system software, the operator interface database, and any third party software installation and integration required for successful operation of the operator interface.

N. Adjusting

1. Calibrating and Adjusting:

a. Coordinate onsite time and integration of services with Division 23 Section "Testing, Adjusting, and Balancing of HVAC" to utilize and mutually support activities. Air and water devices requiring flow information for calibration (i.e., VAV box, flow station/meters, etc.) shall be calibrated in conjunction with TAB activities and shall not interfere with the work and general schedule of construction.

b. Calibrate instruments.

c. Make single-point calibration test for accuracy, plus testing of full span for each analog instrument.

d. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.

e. Control System Inputs and Outputs:

1 Check analog inputs at 0, 50, and 100 percent of span.

2 Check analog outputs using milliampere meter at 0, 50, and 100 percent output.

3 Check digital inputs using jumper wire.

4 Check digital outputs using ohmmeter to test for contact making or breaking.

5 Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

f. Flow:

1 Set differential pressure flow transmitters for 0 and 100 percent values with single-point calibration accomplished at approximately mid-point of span, and check full span with an artificial signal generator.

2 Manually operate flow switches to verify that they make or break contact.

g. Pressure:
   1 Calibrate pressure transmitters at approximately mid-point of span, and check full span with an artificial signal generator.
   2 Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
h. Temperature:
   1 Calibrate resistance temperature transmitters at approximately mid-point of span using a precision-resistance source, and check full span with an artificial signal generator.
   2 Calibrate temperature switches to make or break contacts.
i. Stroke and adjust control valves and dampers, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
j. Provide diagnostic and test instruments for calibration and adjustment of system.
k. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

2. Adjust initial temperature and humidity set points.
3. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

O. Field Quality Testing

1. Perform the following field tests and inspections and prepare test reports:
   a. Category 5e UTP Cabling Tests:
      1 Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in Annex I, complying with measurement accuracy specified in Annex H. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
      2 Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
      3 Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.
      4 Channel and permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal-level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with minimum criteria in TIA/EIA-568-B.2.
   b. Category 6 UTP Cabling Tests:
      1 Tests shall include all tests of Category 5e, conducted from 1 to 250 MHz.
      2 Channel and permanent link tests shall be performed with at ester that complies with performance requirements in TIA/EIA-568-B.2, Level III. Include tests for longitudinal or transverse conversion loss.
      3 Performance shall comply with minimum criteria in TIA/EIA-568-B.2.

2. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
3. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
4. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.

P. STABILITY TRENDING SET-UP

1. Set up trending of points for confirmation of stability and control.
2. Trend three weeks of data as follows:
   a. Trend all analog input values on a 30 minute basis.
   b. Trend all digital input points on a change of value basis.
   c. Trend all analog virtual points on a 60 minute basis.
3. Test network capacity according to standards indicated during trending tests.
4. When trending indicates system instability for certain points, set-up additional trending for one week as follows to facilitate tuning and trouble-shooting:
   a. Trend all associated analog input points on a 10 minute basis.
   b. Trend all associated digital input points on a change of value basis.
   c. Trend all associated analog outputs on a 10 minute basis.
   d. Trend all associated digital outputs on a change of value basis.
   e. Trend all associated virtual analog points on a 10 minute basis.
   f. Trend all associated virtual digital points on a change of value basis.
5. Reporting system shall automatically email trend reports to the Engineer and the Commissioning Agent on a daily basis.
6. Continue trending as long as required to enable system stability and trouble shooting. Owner's representative must sign off.
7. Leave trending of point as directed by Owner's representative for long term information gathering.

Q. DEMONSTRATION

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 for additional requirements.
2. 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 outlets. Refer to Division 01 for additional requirements.

3.23 FINAL ACCEPTANCE

A. The HVAC Sub-Contractor shall leave all system components in proper working order, such as belt guards in place, access doors closed, doors to electrical switch boxes closed, thermostats restored to specified setting. All recorded data shall represent a true, actually measured, or observed condition. Any abnormal conditions in the mechanical systems or

conditions that prevent total system balance shall be reported to the Architect immediately upon finding. The HVAC Sub-Contractor shall permanently mark all dampers and other adjustment devices in a manner that will allow the settings to be restored.

B. The HVAC Sub-Contractor shall verify control system operation as specified, and shall report all system problems and malfunctions. The verification and checkout of the control system shall be accomplished during the heating and cooling cycles of operation for an appropriate period of time to assure control response and overall stability.

C. The HVAC Sub-Contractor shall verify that all air systems are in compliance with all standards, such as ASHRAE minimum outside air, and all other applicable codes and requirements.

D. All filters shall be replaced by the HVAC Sub-Contractor before commencing.

E. The HVAC Sub-Contractor shall make any necessary changes in fan speed, and shall realign all belts when necessary.

3.24 AIR BALANCING

A. The HVAC Subcontractor shall employ an independent TAB Sub-Contractor, acceptable to and approved by the Architect/Engineer, to balance and adjust the air systems.

B. Balancing and adjusting shall not begin until all HVAC systems have been installed and are in full working order. Prior to the start of balancing, the following shall be checked:

1. Rotation of all fans.
2. Dampers are free to open and close
3. Clean filters are in place.

C. Upon completion of balancing and adjusting of the systems hereinafter specified, submit six (6) copies of the data for review and approval by the Architect/Engineer.

D. The TAB Sub-Contractor shall be procured early enough in the project to allow for him/her to review the project documents and determine if sufficient components are in place to balance and adjust the systems. The TAB Sub-Contract shall provide a list of any deficient are he/she identifies.

E. TAB Sub-Contractor shall provide all testing instruments, manpower, temporally connections and materials needed for balancing and adjusting of the air systems. All test instruments should have been calibrated within the last six (6) months. The TAB Sub-Contractor shall provide verification of calibration upon request.

F. Architect/Engineer and Owner shall be notified a minimum of five (5) days prior to balancing commencing so that a representative can be available to witness the balancing work. In addition, the TAB Sub-Contractor shall (upon completion of the balancing work and report submittal), at the request of the Architect/Engineer or Owner's representative, verify the balancing readings at four (4) locations. The locations shall be chosen by the Architect/Engineer or Owner's representative.

G. All balancing and adjusting of air systems shall be done in accordance with the latest edition of the NEBB procedural Standards for Testing, Adjusting and Balancing of

Environmental systems or the latest edition of SMACNA's HVAC Systems Testing, Adjusting and Balancing.

1. Balancing of air systems with Constant Airflow Regulators shall follow the recommendations of the manufacturer American Aldes or approved substitute product.

H. Balancing of the cooling systems shall be performed in the air conditioning season, heating systems in the heating season.

I. Prior to balancing of the air systems, and as part of the balancing report, the TAB Sub-Contractor shall prepare ductwork schematics of the systems to be balanced. Schematics shall be similar to those indicated in the NEBB and SMACNA publications previously identified.

J. Air Balancing Report forms shall be similar to the standard NEBB and SMACNA forms found in the previously identified manuals. The following information shall be provided at minimum (reports for equipment and systems not indicated shall be obtained from the NEBB/SMACNA manuals or prepared by the TAB Sub-Contractor. Reports prepared by the TAB Sub-Contractor shall be submitted for review and approval prior to final Balancing Report submittal):

1. Air Apparatus Test Report
    a. Location.
    b. System Number.
    c. Manufacturer.
    d. Airflow - design and actual.
    e. Total CFM.
    f. Total Static pressure.
    g. Discharge Static Pressure.
    h. Suction Static Pressure.
    i. Coil pressure drops (static pressure).
    j. Filter pressure drops.
    k. Motor volts and amps.
    l. Outside Air and Return Air CFM.
    m. Drive data.
2. Fan Test Report
    a. System Number.
    b. Location.
    c. Manufacturer.
    d. Airflow - design and actual.
    e. Total static pressure - design and actual.
    f. Inlet static pressure.
    g. Discharge static pressure.
    h. Motor and Drive data.
    i. Fan RPM.
    j. Voltage and Amperage.

3. Duct Traverse
    a. System zone/branch.
    b. Duct Size.
    c. Area.
    d. Design Velocity.
    e. Design Airflow.
    f. Test Velocity.
    g. Test Airflow.
    h. Duct Static Pressure.
    i. Air temperature.
4. Air Outlet Report
    a. Area Served.
    b. Outlet Number.
    c. Type.
    d. Size.
    e. AK factor.
    f. Velocity - design and actual.
    g. Airflow - design and actual.

K. The TAB Sub-Contractor shall balance and adjust air systems to meet design requirements. ±5%. Balancing shall be accomplished by adjusting dampers, drives, etc. to obtain design requirements.

L. The HVAC Sub-Contractor shall cooperate and make provisions for the TAB Sub-Contractor as needed to accommodate the air balancing. As part of this Contract, the HVAC Sub-Contractor shall provide and/or change pulleys, belts and sheaves, and dampers, at no additional cost, in order to properly balance the systems to design requirements.

3.25 START UP AND TESTING OF COOLING AND HEATING EQUIPMENT

A. All cooling equipment shall be tested to verify that the equipment operates mechanically and electrically as specified.

B. All heating equipment shall be tested to verify that the equipment operates mechanically and electrically as specified.

C. The HVAC Sub-Contractor shall verify that all operating and safety controls are correctly adjusted.

D. The HVAC Sub-Contractor shall verify that the cooling equipment controls are operating properly.

E. Tests shall be made to verify that the capacity control is fully modulating according to the required load. Tests shall be made at minimum load, 50% load, 100% load and various other loads throughout the modulating cycle.

F. The HVAC Sub-Contractor shall record the following non-test data:

1. Equipment designation number.

2. Equipment manufacturer.
3. Model number.
4. Serial number.
5. Rated input.
6. Rated output.
7. All other pertinent data.

G. The HVAC Sub-Contractor shall perform and record the following to meet minimum requirements:

1. Verify proper system operation.
2. Verify that the cooling system controls are operating according to design specifications.
3. All other measurements required for complete system testing.

H. The HVAC Sub-Contractor shall calculate the system coefficient of performance as measured. All calculations made using the measured data shall be included in the report. In general, the HVAC Sub-Contractor shall complete all tests necessary for complete cooling and heating systems analysis.

3.26 COMMISSIONING OF HVAC EQUIPMENT AND SYSTEMS

A. TESTING PREPARATION

1. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
2. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
3. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
4. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
5. Inspect and verify the position of each device and interlock identified on checklists.
6. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
7. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

B. TESTING AND BALANCING VERIFICATION

1. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
2. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
3. During Functional Testing the CxA shall spot-check airflows and equipment operation. The TAB contractor shall be required to re-calibrate if any of the following instances occur:
   a. Any diffuser, grille, or other air flow device is excessively loud.

b. Any item is observed to be operating improperly.

c. A discrepancy between the recorded information on the TAB report and field observations during functional testing.

C. GENERAL TESTING REQUIREMENTS

1. Provide control system technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
2. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
3. Test operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
4. The CxA shall prepare detailed functional testing plans, for HVAC&R systems, subsystems, controls, and equipment.
5. Tests will be performed using design conditions whenever possible.
6. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. In most cases the artificial loads will be simulated by adjusting setpoints and manipulating controls. In some cases the contractor may be required to provide equipment to simulate loads.
7. The CxA may direct that set points be altered when simulating conditions is not practical.
8. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
9. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
10. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.
11. If, in the CxA's sole judgment the systems or equipment fail to perform according to the design intent, a list of deficiencies will be generated which, when remedied, shall result in retesting of the deficiency, as well as the system as a whole.

3.27 SEQUENCES OF OPERATION

A. Refer to HVAC floor plans and Piping Schematics located on the drawings for equipment designations and locations.

B. Common Requirements for Sequences of Operation: The following items are common requirements that apply unless noted otherwise:

1. All setpoints shall be program adjustable at the operator workstation.
2. All high and low limits shall be alarmed.
3. All cooling coils located in or over occupied spaces shall have a condensate pan high level alarm.
4. All fan proof of operation shall be by high and low current sensors.

5. All unit smoke detection, freeze protection, high condensate level and other emergency shutdown shall be done by hardwired relay interlock and shall not rely on control system programming.
6. All dampers shall have open and close status indication through end switches or integral actuator feature.
7. All dampers shall have an independent control point. Multiple dampers of different applications (i.e., outdoor, return, relief) controlled from a single point are not acceptable.
8. All air handling systems with ducted outdoor air shall be provided with freeze protection.

C. All spaces shall have the capability of being individually scheduled for Occupied and Unoccupied periods.

D. Variable Refrigerant Volume Heat Pump (VRV) System

1. The variable refrigerant volume heat pump system will have a manufacturer provided control system.
2. The ATC sub-contractor shall provide all required control wiring between air handlers, condensing units, control panels, etc., per the manufacturer's recommendations and requirements.
3. The HVAC sub-contractor shall provide the set-up of the VRV system manufacturer provided control system. The ATC sub-contractor shall assist the HVAC sub-contractor in identifying any requirements of the system for integration with the DDC system.
4. The variable refrigerant volume heat pump system shall operate on internal controls to modulate the compressors to provide heating or cooling as required.
5. Indoor Fan Coil Units
   a. The indoor units shall be controlled by MA controllers.
   b. During occupied periods, the indoor units shall operate to maintain the space controller heating and cooling setpoints.
   c. The space controller setpoint shall be determined by the central control system unless overridden at the space controller.
   d. During unoccupied periods, the indoor units shall operate to maintain the unoccupied setpoint temperature.
   e. Rooms with multiple indoor units shall have all units controlled from a single controller unless multiple controllers are indicated on the drawings.

E. Energy Recovery Ventilator (Offices and General Spaces)

1. ERV-100 shall be provided with a communication card to allow interface with the DDC system.
2. ERV-100 shall be energized and run continuously during occupied hours as determined by a schedule in the DDC system.
3. When ERV-100 is energized:
   a. The supply and exhaust fans shall be energized and run continuously.
      1 The supply air fan shall modulate as required to maintain the supply air duct static pressure setpoint, initial setpoint of 0.5" (adjustable). The final duct static pressure setpoint to be determined during balancing.

2 The exhaust fan shall modulate as required to maintain the space at 0.05" SP above outdoors.

b. If the ERV supply discharge air temperature is below the heating supply air temperature setpoint of 70ºF (adjustable) and the enthalpy wheel is energized, the heat pump and DX coil with associated LEV kits shall modulate to maintain the supply air temperature setpoint of 70ºF (adjustable).

1 If the ERV supply discharge air temperature is greater than the supply air heating mode temperature setpoint, the heat pump shall be de-energized.

c. If the ERV supply discharge air temperature is above the cooling supply air temperature setpoint of 75ºF (adjustable) and the enthalpy wheel is energized, the heat pump and DX coil with associated LEV kits shall modulate to maintain the supply air temperature setpoint of 75ºF (adjustable).

1 If the ERV supply discharge air temperature is less than the supply air cooling mode temperature setpoint, the heat pump shall be de-energized.

d. If the space RH level is greater than 55%RH (adjustable) the ERV shall operate in dehumidification mode, heat pump and DX coil with associated LEV kits shall be energized at 100% and the reheat coil shall modulate to maintain the space cooling supply air temperature setpoint.

1 When the space RH level drops to below 50% RH (adjustable) the dehumidification mode shall be disabled.

4. Enthalpy Wheel

a. When the outdoor air temperature is between 65ºF and 75ºF (adjustable), the enthalpy wheel shall be de-energized.

5. When ERV-100 is de-energized:

a. The supply and exhaust fans shall be de-energized.

b. The supply and exhaust dampers shall be closed.

F. Constant Airflow Regulators

1. Singles stage airflow regulators shall always be open.

2. Two stage regulators shall have the first stage open at all times. The second stage (booster) damper shall be interlocked with the associated space's occupancy sensor (room or lighting fixture) and shall open the second stage damper when occupancy is sensed. The damper shall close when the occupancy period ends.

3. Multi-Purpose Room

a. The space mounted CO2 sensors shall control operation of the associated outside air VAV boxes.

b. During Occupied periods the supply VAV box shall open to the minimum airflow.

c. On a rise in space CO2 above 900 ppm (adjustable) the VAV box damper shall modulate open.

d. On a drop in space CO2 below 600 ppm (adjustable) the VAV box damper shall modulate to the minimum airflow position.

e. The exhaust VAV box shall track the supply VAV box.

G. HVAC Unit with Integral ERV (Gymnasium)

1. ERV-200 shall be provided with a communication card to allow interface with the DDC system.

2. ERV-200 shall be energized and run continuously during occupied hours as determined by a schedule in the DDC system.
3. When ERV-200 is energized:
    a. The supply and exhaust fans shall be energized and run continuously.
        1 The supply air fan shall operate at the design CFM.
        2 The outside air shall modulate based on space CO2 (see below)
        3 The exhaust fan shall modulate as required to maintain the space at 0.05" SP above outdoors.
    b. If the space air temperature is below the space heating temperature setpoint the heat pump and DX coil with associated LEV kits shall modulate the supply air temperature as required to maintain the space heating setpoint of 70ºF (adjustable).
        1 If the ERV supply discharge air temperature is greater than the supply air heating mode temperature setpoint, the heat pump shall be de-energized.
    c. If the space air temperature is above the space cooling temperature setpoint the heat pump and DX coil with associated LEV kits shall modulate the supply air temperature as required to maintain the space cooling setpoint of 75ºF (adjustable).
        1 If the ERV supply discharge air temperature is less than the supply air cooling mode temperature setpoint, the heat pump shall be de-energized.
    d. If the space RH level is greater than 55%RH (adjustable) the ERV shall operate in dehumidification mode, the heat pump and DX coil with associated LEV kits shall be energized at 100% and the reheat coil shall modulate to maintain the space cooling supply air temperature setpoint.
        1 When the space RH level drops to below 50% RH (adjustable) the dehumidification mode shall be disabled.
    e. The outside air dampers shall modulate as required to maintain the space CO2 setpoint of 600 PPM (adjustable).
4. Enthalpy Wheel
    a. When the outdoor air temperature is between 55ºF and 75ºF (adjustable), the wheel shall be de-energized.
5. When ERV-200 is de-energized:
    a. The supply and exhaust fans shall be de-energized.
    b. The supply and exhaust dampers shall be closed.
6. Unoccupied mode
    a. If there is a call for space heating during unoccupied periods the unit shall be energized in 100% recirculation mode and the gas furnace section shall be energized as required to satisfy the unoccupied space heating temperature setpoint of 60°F (adjustable).
    b. Cooling mode shall be disabled during unoccupied periods.

H. Electric Heating Devices

1. Electric heating devices shall be controlled by their integral or space mounted thermostats.
2. On a demand for space heating the fan and heating element shall be energized.
    a. When the space temperature is satisfied the fan and the heating element shall be

deenergized.

I. Ductless Split System Air Conditioners – Cooling only

1. Ductless split system air conditioners shall be controlled by the packaged controls.
2. On a call for cooling from the space thermostat the fan shall be energized and the compressor shall operate to satisfy the space demand.
   a. When the space temperature is satisfied the fan and the condensing unit shall be deenergized.
3. The ATC sub-contractor shall provide all control wiring between the indoor and outdoor units and between the thermostat/controller and the system.

- END OF SECTION -

SECTION 260000 – ELECTRICAL

1 GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT, CONDITIONS OF THE CONTRACT, and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, including, but not limited to, the following:

1. Complete building secondary power distribution system with lighting and power distribution panelboards, and all feeders.
2. All branch power circuits to all building operational equipment including but not limited to, lighting fixtures, power outlets, mechanical heating and cooling equipment and as required for all special systems components.
3. Complete grounding system as required by Article 250 of the National Electrical Code.
4. Complete raceway system with conduits, conduit fittings, outlet boxes, wire ways, hangers, supports, and all incidental items as required for a complete installation. Raceway systems installed exposed in all finished areas shall be specifically designed for the application.
5. All wiring devices including light switches, duplex receptacles and special power outlets. Provide cover plates for all wiring devices.
6. All lighting fixtures including emergency and exit lights complete with lamps, ballasts, and starters as shown on the Drawings.
7. Fire alarm system.
8. Telecommunications, video distribution services as shown on design drawings.
9. Complete wiring of all items of equipment furnished by the Owner and/or under other Sections of these Specifications.
10. Vendor services, testing and training.
11. All devices and products under this section are to meet the voltage requirements available on site. It the Electrical Contractor’s responsibility to ensure this.

B. Items to be installed only: Install items as furnished by the following designated sections:

1. FIRE PROTECTION
2. PLUMBING
3. AIR CONDITIONING

C. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. SECTION GENERAL CONDITIONS OF THE CONTRACT.
    a. Cutting, patching and drilling, except installation of pipe supports and fastenings.
2. CAST-IN-PLACE CONCRETE.

a. All concrete work.

3. COMMISSIONING – SEE SECTION 018100 AND PROVIDE ACCORDINGLY. All Electrical commissioning requirements in Section 018100 – General Commissioning Requirements.

D. Extent: The work required under this Section, without limiting the generality thereof, includes the furnishing of all labor and materials required to supply and distribute proper power, including all conduit and controls, to all electrical fixtures, accessories, devices, motors, motor controllers, etc., and the special systems called for under all Sections of the Specifications, and all other materials, equipment, and labor necessary, whether or not such items are specifically indicated on the Drawings or in the Specifications to complete the electrical work, in all respects ready for continuous and trouble free operation.

E. Intent: It is the intent of the Contract Documents to include all work and materials necessary for erecting complete, ready for continuous use, all electrical and special systems shown on the accompanying Drawings, or as hereinafter described. These Drawings shall be taken in a sense as diagrammatic; branch circuit runs, electrical equipment, etc. and methods of running them are shown, but it is not intended to show every fitting, wire, or device, nor every structural difficulty that will be encountered during the installation of the work.

1.3 SCOPE OF WORK

1. Coordinate all work in this Section with related trades.
2. Furnish all materials, equipment, supplies, transportation and labor, and perform all operations necessary in the installation of all electrical work, complete and in operating condition.
3. Examine the drawings and specifications and determine work to be performed by the electrical and other trades. Provide the type and quantity of electrical materials and equipment necessary to complete this work and place all systems in proper operation, tested and ready for use.
4. Work Included: In general, the electrical work shall consist of, but not be limited to, the following:
   a. Incidental items not indicated on the drawings nor mentioned in the specifications that belong to the work described or are required to provide a complete system as though called out here in every detail.
   b. Acquire all permits as may be necessary to perform the specified work.
5. Work Related to the Mechanical Trade, shall be included under the Electrical Section of the Work. Coordinate work with the Mechanical Contractor.
6. The requirements of authorities shall be the minimum acceptable requirements for the work and nothing described in these specifications or indicated on the drawings shall be construed to permit work not conforming to the most stringent of the applicable codes and regulations.
7. When drawings or specifications call for materials or construction of better quality or larger size than required by codes, laws, rules and regulations, the drawings and specifications shall take precedence.
8. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Architect immediately and cease work on all parts of the Contract which are affected until approval for any required modifications to the construction has been obtained from the Architect.

B. WORK RESPONSIBILITIES

1. Examine the site and all electrical, architectural and other drawings and accept such conditions and make allowance for them in preparing the bid. No extra charges will be considered for costs resulting from failure to comply with the above.
2. The drawings indicate diagrammatically the desired locations or arrangements of conduit runs, outlets, equipment, etc. and are to be followed as closely as possible. Proper judgment must be exercised in executing the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions. The contractor is responsible for the correct placing of his work and the proper location and connection of his work in relation to the work of other trades.
3. Locations shown on architectural and ceiling plans and/or wall elevations shall take precedence over electrical plan locations, but where a major conflict is evident, notify the Architect for instructions prior to commencing work on the same.
4. In the event changes in the indicated locations or arrangements are necessary due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra costs, providing the change is ordered before the conduit runs, etc. and the work directly connected to same is installed and no extra materials are required.
5. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.
6. Where equipment is furnished by others, verify voltage characteristics and dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.
7. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Architect immediately and cease work on all parts of the Contract which are affected until approval for any required modifications to the construction has been obtained from the Architect.
8. Perform all work competent and skilled personnel.
9. All work shall be of the highest quality consistent with the best practices of the trade.
10. Replace or repair, without additional compensation, any work which, in the opinion of the Architect, does not comply with these requirements.
11. The Electrical Contractor shall be responsible for the safety and good condition of all materials and equipment until final acceptance by the Owner; for providing adequate and proper storage facilities during the progress of the work; for replacing all damaged and defective work before applying for final acceptance; for erecting and maintaining suitable barriers, protective devices, light and warning signs for the protection of the public and employees; and for all loss, damage or injury to persons or property resulting from any neglect of these responsibilities.
12. The Contractor shall be responsible for all faults and deficiencies in his work during the guarantee period and shall repair, at no cost to the Owner, all such deficiencies that occur immediately upon notification by the Owner. All damage to other work there from, which may occur during the construction and guarantee period, shall be repaired at once, at no cost to the Owner.

C. INTERPRETATION

1. All requests for interpretation of plans and specifications must be made by the Contractor through the Architect. Any such requests made by equipment manufacturer or suppliers will be referred to the Contractor.

D. SELECTION OF MATERIALS AND EQUIPMENT

1. Specified materials and equipment shall be selected within the operating ranges indicated for efficiency, capacities, noise levels, and projected life. In the absence of specific criteria, conservative commercial practice, in the opinion of the Architect, will apply.
2. Items of a similar application shall be of the same manufacturer.
3. The label of listing by Underwriters Laboratories, Inc. shall appear on all materials and equipment for which standards have been established by that agency.
4. Where local or other authorities have jurisdiction, have established label or approval requirements, furnish all materials and equipment with either the required labels affixed, or the necessary written approval.
5. The equipment plans are designed around standard products of one or more of the manufacturer's listed as being acceptable for the product involved. Where one or more manufacturer is listed as being acceptable for a product, each manufacturer listed for that product shall be considered as "equal" and acceptable.
6. All materials to be free of asbestos and urea formaldehyde.

1.4 QUALITY ASSURANCE

A. Execution:

1. The Electrical Subcontractor shall refer to all the Drawings for a full comprehension of the work to be done and for conditions affecting the location and placement of his equipment and materials. These Drawings are intended to be supplementary to the Specifications and any work indicated, mentioned, or implied in either is to be considered as specified by both. Should the character of the work herein contemplated or any matter pertaining thereto be not sufficiently explained in the Specifications or Drawings, the Electrical Subcontractor may apply to the Architect-Engineer for further information and shall conform to such when given, as it may be consistent with the original intent. The Architect-Engineer reserves the right to make any reasonable changes in location prior to installation at no expense to the Owner. All lines are diagrammatic and exact locations are subject to the approval of the Architect-Engineer.
2. Before submitting his bid, the Electrical Subcontractor shall visit the site with the Drawings and Specifications and shall become thoroughly familiar with all conditions affecting his work since the Electrical Subcontractor will be held responsible for any assumption he may make in regard thereto.
3. The Electrical Subcontractor shall, at all times, have a foreman or superintendent on the project authorized to make decisions and receive instructions as if the Electrical Subcontractor himself were present. The Electrical Subcontractor shall employ only competent and experienced workmen at a regular schedule in harmony with the other tradesmen on the job. The Electrical Subcontractor shall also exercise care and supervision of his employees in regard to proper and expeditious layout of his work.
4. When items in the contract drawings and specifications are in conflict, then the more stringent of the two shall take precedence.

B. Products:

1. All materials used in this Section shall be new, full weight, and first class in every respect, without defects, and designed to function properly in that portion of the work for which they are intended and with the same brand of manufacturers for each class of material or equipment.

2. Equality of material or equipment other than those named or described in this Section will be determined in accordance with the provisions of the Contract and as specified further herein.

C. All work installed under these Drawings and Specifications must be installed in strict accordance with the requirements of all local and other departments having jurisdiction, the utility companies, and with the requirements of the Underwriters' Laboratories, Inc., National Bureau of Fire Underwriters, International Building Code, National Electrical Code 2023 (USA), EIA/TIA Building Telecommunication Wiring Standard, and/or similar codes applied hereto.

1.5 CODES AND STANDARDS

A. Workmanship, material and equipment shall be in accordance with Specifications and Drawings and in some instances the requirements exceed those required by codes and standards. Where not exceeded, the codes and standards shall be considered as absolute minimum requirements. Where conflicts occur between codes the most stringent shall apply.

B. All materials, appliances, equipment and devices provided under this contract must meet the requirements of Underwriters Laboratories (UL) Standards.

C. Refer to NEC, for definitions of terms used in the Drawings, Specifications, etc. These definitions, in conjunction with local authorities interpretation, convention and common usage, will apply.

D. International Building Code.

E. International Fire Code

F. Rhode Island Fire Safety Code.

G. NEC 2023.

1.6 REFERENCE ABBREVIATIONS

A. References are made in the various Electrical Sections to technical societies, codes, specifications, trade organizations, and regulatory authorities in accordance with the following abbreviations:

1. ADA - Americans with Disabilities Act (1992).

2. FM - Factory Mutual

3. IEEE - Institute of Electrical and Electronics Engineers.

4. IPCEA - Insulated Power Cable Engineers Association.

5. NEC - National Electrical Code (NFPA Pamphlet No. 70).

6. NEMA - National Electrical Manufacturer's Association.

7. NETA - International Electrical Testing Association, Inc.

8. NFPA - National Fire Protection Association.

9. UL - Underwriters Laboratories, Inc.

1.7 SHOP DRAWINGS AND DATA TO BE SUBMITTED

A. Within 30 days of award of the Contract, the Electrical Subcontractor shall submit, for approval, six (6) copies of a complete list of manufacturer's shop drawings, detail prints and data.

B. **Items with lead times exceeding 6 months shall be submitted within 2 weeks of the contract being accepted. Unusual lead times shall explicitly be stated in the submittal including potential project impacts.**

C. Reference catalog cuts and brochures of products to proper paragraph in Specifications. Furnish numerical index by Specifications paragraph number listing product name, catalog number and reference to page number of submittal brochure.

D. Cross reference individual catalog numbers of substitute products to numbers of specified materials.

E. Bind submittal in booklet form.

F. Requests for permission to use substitute or alternate products shall be accompanied with evidence to prove that the product:

1. Conforms to the standard of performance and quality specified.

2. Will physically fit in the space allocated, with sufficient access and maintenance space.

3. Will not entail changes in details and construction of related work whether mechanical, electrical, or general in nature.

4. Involves no additional costs to the Owner or extended construction time.

G. Requests for permission to use substitute or alternate products shall be immediately brought to the Architect’s attention. In the event that the use of these products may be determined to result in a material or labor savings to the Contractor, then the amount of these savings as a credit to the Owner will be required to assist in determination of acceptability of the product. Provide drawings, specifications, samples, performance data and other information as may be required to assist in determination of acceptability of the product.

H. Equipment Items

1. Submit manufacturer's certified data relative to equipment required for the installation of the electrical systems.

2. Submit adequate engineering data on each piece of equipment to allow a careful check of compliance with the technical requirements of the Contract Documents. Clearly indicate on submitted data the manufacturer's name, piece number, equipment capacity, and other applicable technical data.

3. Data and drawings for Electrical Systems:

a. Disconnect Safety Switches

b. Fire Alarm System

c. Wiring Devices

d. Panel boards

e. Raceways and Fittings

f. Switchboards

g. Underground Conduit

h. Security System

i. Telephone/Data Systems

j. Wires and Cables

k. Transient Voltage Surge Suppressor

l. Lighting Fixtures and Controls

4. Shop Drawings: Submit 1/4-inch minimum scale coordinated Shop Drawings relating to the equipment, and foundations, and dimensioned locations of each, including accessories, and showing clearances for operating and servicing. Provide a detailed layout of electrical rooms.

   a. Major conductor routing

   b. Major electrical equipment.

5. Do not release for shipment, deliver, or install any equipment or material without the prior approval of the Architect-Engineer.

1.8 OPERATING AND MAINTENANCE MANUALS

A. Bind in loose-leaf binders with the words, "Operating and Maintenance Manual" and the Project identification imprinted on the cover. Prepare three complete sets of records for the Owner, with table of contents, index, and tabbed section dividers.

B. During the construction period, accumulate the following for inclusion in the Operating and Maintenance Manuals:

1. Copies of warranties and guarantees on each piece of equipment installed.

2. Fixture brochures.

3. Wiring and control diagrams.

4. Approved Shop Drawings.

5. Operating instructions for:

   a. Electrical Systems

   b. Fire Alarm System

   c. Lighting Control System

6. Recommended maintenance procedures.

7. Lists of major items of equipment with name, address, and telephone number of each local representative.

C. Submit the manuals for approval at approximately 75 percent job completion.

D. Each manual shall consist of:

1. Complete description of each item of equipment and apparatus furnished and installed including ratings, capacities, and characteristics.

2. Fully detailed parts list, including all numbered parts of each item of equipment and apparatus furnished and installed.
3. Manufacturer's printed instructions describing operation, servicing, maintenance and repair of each item of equipment and apparatus.
4. Typewritten record of all tests made of materials, equipment, and systems. All such records shall state the date tests were conducted, the names of all persons making and witnessing the tests, and citing any unusual conditions relevant to the tests.

1.9 DELIVERY, STORAGE, AND HANDLING

A. The Electrical Subcontractor shall provide for the delivery of all his materials and fixtures to the building site when required so as to carry on his work efficiently and to avoid delaying his work and that of other trades.

B. The Electrical Subcontractor shall, at all times, fully protect his work and materials from injury or loss by others. Any injury or loss, which may occur, shall be made good without expense to the Owner. The Electrical Subcontractor shall be responsible for the proper protection of all his materials until the Owner accepts the building.

1.10 GUARANTEE/WARRANTY

A. The Electrical Subcontractor shall and hereby does warrant that all work executed and all equipment furnished under this Section shall be free from defects of workmanship and materials for a period of one year from date of final acceptance of this work. The Electrical Subcontractor further agrees that he will, at his own expense, repair and replace all such defective work and all other work damaged thereby which becomes defective during the term of the Guarantee/Warranty.

1.11 RECORD DRAWINGS

A. Accumulate Record Drawings during the construction of the project. Keep one (1) set of Contract Drawings at the job site at all times, and mark changes, rerouting or modifications which occur, clearly on the Drawings with dimensions.

B. At completion of the job, obtain electronic drawings from the Architect and transfer the notations indicating changes to them. Reproducible drawings shall be submitted for review prior to final payment. Submit a complete set of reproducible drawings together with AutoCAD 2006 electronic drawings prior to final payment.

1.12 OWNER-FURNISHED, CONTRACTOR-INSTALLED EQUIPMENT

A. Install and make all necessary electrical connections to scheduled/designated Owner-furnished equipment. Scope and content will be defined by the Architect/Owner.

1.13 TEMPORARY LIGHT AND POWER

A. This Contractor shall furnish, install, maintain and remove at completion of work necessary temporary electrical distribution wiring.

B. Include a 208Y120V, 400 amp, 3-phase service at minimum.

C. Temporary light shall be based on 100W lamp for rooms up to 500 sq. ft. and two (2) 200W lamps for every 1000 sq. ft. or fraction thereof. All lamps shall be furnished and replaced by this Contractor. In tenant open area spaces, temporary lighting shall be provided with bird cage type temporary fixtures on a 25 ft grid.

D. Panel boards, switches, receptacles, poles, transformer, metering and accessories required for temporary light and power installation shall be provided.

E. Outlets shall be located at convenient points so that extension cords of not over fifty (50) feet will reach work requiring temporary light and power.

F. The General Contractor and Subcontractors, individually, shall furnish cords, sockets, motors and accessories for their work.

G. Temporary wiring, service equipment and accessories thereto installed, shall be removed at the expense of this Contractor after they have served their purpose.

H. The General Contractor is required to pay the cost of electricity consumed by himself and by his Subcontractors. This Contractor shall pay for replacement of lamps broken and/or removed from the premises during the construction period and until date of substantial completion as determined by Architect.

I. Temporary work shall be furnished and installed in conformance with OSHA, local codes and ordinances.

J. The Electrical Contractor shall install and maintain in each section of the building sufficient power for the requirements of the entire wing.

K. The Electrical Contractor shall supply power for the General Contractor's and Clerk of the Work's trailers.

1.14 LOW-VOLTAGE SYSTEMS

SEE SECTION 270000 AND 280000

2 PRODUCTS

2.1 GENERAL PROVISIONS FOR ELECTRICAL WORK

A. SUMMARY

1. The Specifications for accompanying drawings are intended to secure the provision of all material and labor necessary for complete electrical installation tested and ready for service, and as called for herein and as indicated on the drawings. Each system shall be complete and shall include all the necessary appurtenances and minor auxiliaries required to make it functional and complete in every respect.
2. All materials shall be new and shall conform to the standard of the Underwriters Laboratories, Inc. Materials shall be fabricated in accordance with the specifications and approved rules and regulations of NEMA and shall be UL listed and labeled. Materials and apparatus for like services shall be by the same manufacturer.
3. Provide a complete electrical system as described herein and / or as shown on the drawings.

B. CODES AND PERMITS

1. The requirements of the National Electrical Code, the rules and regulations of state and municipal authorities having jurisdiction, the construction requirements of NEMA, NFPA, ANSI, OSHA and BOCA shall be observed and shall govern all materials furnished and installation methods applied.
2. The Contractor of electrical work shall obtain all necessary permits and certificates, in compliance with the codes, applicable laws and municipal regulations, and shall deliver these to the Owner/Engineer before final acceptance of his work.

C. SITE VISIT

1. Bidders, before submitting proposals, shall visit and carefully examine the site affected by this work to familiarize themselves with existing conditions and with the difficulties that may attend the execution of this work. Bidders shall also consider

the eventuality of having to perform certain tasks on premium time, outside of normal working hours. Submission of a proposal with appropriate references to potential scheduling concerns will be construed as evidence that such an examination has been made and proper consideration given. Later claims for more labor, equipment or materials, required because of difficulties encountered, will not be recognized.

2. The Contractor for the electrical work shall also examine the general construction and mechanical/plumbing plans and specifications, insofar as labor and materials and type of construction, etc., may affect the electrical examination has been made. No later claims for extra work resulting from failure to do so will be recognized.

D. CUTTING AND PATCHING

1. The Contractor shall seal all conduit/cable penetrations through fire rated walls with approved, UL listed fire sealant to match the required fire ratings.
2. Where required by drawings, the Electrical Contractor shall repair or replace paved areas disturbed by the installation of underground conduits and / or cables. Patched or re-paved areas shall be completed using appropriate and suitable materials and methods to effect a permanent repair.

E. ACCEPTANCE

1. Seven (7) days prior to date of requested Final Inspection, Contractor shall:
   a. After the completion of the work, the electrical contractor shall test and demonstrate to the satisfaction and approval of the Owner, Engineer or their representatives all systems in perfect working order, using instruments or by actual operation of the system.
   b. Furnish engineer required maintenance manual, parts list, operating instructions, wiring diagrams, and electric control diagram.

F. CLEANING AND ADJUSTMENTS

1. Upon completion of work, contractor shall clean and lubricate fans, motors, and other running equipment and apparatus, which he has installed and make certain such apparatus and equipment are in proper working order and ready for tests.
2. Scratched or damaged painting shall be touched up with appropriate materials and methods as necessary to return the painting to a new condition and appearance.

G. RACEWAYS AND CONDUCTORS

1. Electrical metallic tubing shall be thin wall steel pipe, minimum size 1/2", and may be used in hung ceilings, dry hollow partitions, hollow block walls, and exposed in dry locations. Fitting shall consist of compression or set screw type of connectors.
2. Underground rigid nonmetallic conduit shall be NEMA TC2, Schedule 40 PVC with NEMA TC3 fittings.
3. Flexible steel conduit shall be galvanized, minimum ¾", and may be used for final connections to motors and recessed fixtures in dry locations.
4. Liquid tight, flexible conduit shall be zinc coated with PVC jacket. It shall be used for final connections to motors.
5. Conductors shall be 600 V Type THW, THWN, or THHN, color coded, minimum size #12 AWG.
6. All raceways shall be concealed in walls, floors or ceiling. All indoor conduit shall be EMT unless otherwise approved.
7. All conductors shall be copper.

8. Branch circuits more than 100 feet long shall be #10 AWG for the entire length, up to the first outlet or junction box.
9. Exposed conduit shall be painted prior to installation to match the background color.

H. OUTLET BOXES
1. Pressed steel, galvanized, code gauge, and shall be used for wiring devices in concealed work.

I. WIRING DEVICES
1. Receptacles shall have configuration in accordance with NEMA standards, for voltage and current rating as required by capacity of equipment served and corresponding branch circuit protection. As a minimum, receptacles shall be of the grounded type, 15A, 125V AC, Hubbell No. #5262 or approved equal.
2. Ground Fault receptacles, if required, shall be minimum of 20A, 125V in conformance with NEMA WD-1.10 standard.
3. Exposed pull boxes shall be of proper size and type to satisfy the specific application.
4. Safety switches, heavy duty type with or without fuses, size and NEMA enclosure type as shown on drawings.

J. GROUNDING
1. Equipment ground shall consist of grounding all metallic non-current carrying components of electrical system (conduit system, cabinets, frames of motors, panelboards, etc.). Metallic raceways shall effectively and permanently maintain continuity of ground between equipment. Grounding source for equipment ground shall be the same as for the service ground. Mechanical equipment, machinery, etc., shall also be effectively grounded. Equipment grounding conductors shall be run in all raceways.
2. **Grounding electrode system is existing to remain.**

2.2 BASIC ELECTRICAL MATERIALS AND METHODS

A. SUMMARY
1. This Section includes the following:
a. Raceways
b. Building wire and connectors
c. Supporting devices for electrical components
d. Electrical identification
e. Electricity-metering components
f. Concrete equipment bases
g. Cutting and patching for electrical construction
h. Touchup painting

B. DEFINITIONS
1. EMT: Electrical metallic tubing
2. FMC: Flexible metal conduit
3. IMC: Intermediate metal conduit
4. LFMC: Liquid tight flexible metal conduit
5. RNC: Rigid non-metallic conduit

C. COORDINATION

1. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
    a. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
2. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the work. Coordinate installing large equipment requiring positioning before closing in the building.
3. Coordinate electrical service connections to components furnished by utility companies.
    a. Coordinate installation and connection of exterior underground and overhead utilities and services, including provisions for electricity metering components.
    b. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
4. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Section "Access Doors."
5. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
6. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

D. RACEWAYS
1. EMT: ANSI C80.3, zinc-coated steel, with set-screw or compression fittings.
2. FMC: Zinc-coated steel
3. IMC: ANSI C80.6, zinc-coated steel, with threaded fittings
4. LFMC: Zinc-coated steel with sunlight resistant and mineral-oil-resistant plastic jacket
5. RNC: NEMA TC2, Schedule 40 PVC, with NEMA TC3 fittings
6. Raceway Fittings: Specifically designed for the raceway type with which used.

E. CONDUCTORS
1. Conductors, No. 10 AWG and Smaller: Solid copper.
2. Conductors, Larger Than No. 10 AWG: Stranded copper.
3. Insulation: Thermoplastic, rated at 75 deg C minimum.
4. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

F. SUPPORTING DEVICES
1. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
2. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
3. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch diameter slotted holes at a maximum of 2 inches o.c., in webs.
4. Slotted-Steel Channel Supports: Comply with Division 5 Section "Metal Fabrications" for slotted channel framing.

a. Channel Thickness: Selected to suit structural loading.
b. Fittings and Accessories: Products of the same manufacturer as channel supports.

5. Non-metallic Channel and Angle Systems: Structural grade, factory formed, glass fiber resin channels and angles with 9/16-inch diameter holes at a maximum of 8 inches o.c., in at least one surface.
   a. Fittings and Accessories: Products of the same manufacturer as channels and angles.
   b. Fittings and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
6. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps or click type hangers.
7. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
8. Cable Supports for Vertical Conduit: Factory fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable iron casting with hot-dip galvanized finish.
9. Expansion Anchors: Carbon steel wedge or sleeve type.
10. Toggle Bolts: All steel springhead type.
11. Power Driven Threaded Studs: Heat treated steel.

G. ELECTRICAL IDENTIFICATION

1. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A 13.1, NFPA 70, and these Specifications.
2. Raceway and Cable Labels: Comply with ANSI Al 3.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.
   a. Type: Preprinted, flexible, self adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
   b. Color: Black letters on orange background.
   c. Legend: Indicates voltage.
3. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick.
4. Underground Warning Tape: Permanent, bright colored, continuous printed, vinyl tape with the following features;
   a. NOT less man 6 inches wide by 4 mils thick.
   b. Compounded for permanent direct burial service.
   c. Embedded continuous metallic strip or core.
   d. Printed legend that indicates type of underground line.
5. Tape Markers for Wire: Vinyl or vinyl cloth, self-adhesive, wraparound type with preprinted numbers and letters.
6. Color Coding Cable Ties: Type 6/6 nylon, self locking type. Colors to suit coding scheme.

7. Engraved Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.
8. Fasteners for Nameplates and Signs: Self tapping, stainless steel screws or No. 10/32 stainless steel machine screws with nuts and flat and lock washers.

H. EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

1. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
2. Meter Sockets: Comply with requirements of electrical power utility company.

I. TOUCHUP PAINT

1. For Equipment: Equipment manufacturer’s paint selected to match installed equipment finish.
2. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

2.3 ACCEPTABLE MANUFACTURERS

A. Manufacturer's names and catalog numbers are scheduled or specified for the purpose of establishing standard of design, quality, appearance, performance and serviceability, and not to limit competition. Scheduled products (as may be modified by detailed specifications) are those selected as the basis for system design with respect to physical size and space arrangements, required capacity and performance characteristics, and the product quality intended.

B. The Drawings indicate scheduled products physically arranged in the spaces, based on catalog data of specific manufacturers.

C. Listed "Acceptable Manufacturers" are those considered capable of manufacturing products conforming to detailed specifications, and as such, are invited to compete on an equal basis provided the offering is comparable in every respect to scheduled or specified products and actually conforms to the detailed specifications and schedule requirements. Listing herein as "acceptable manufacturers" does not imply "accepted", "approved", "prior approval", or any other such connotation. All product offerings must be submitted for approval after Contract award.

D. Vendors are invited to submit material or equipment bids to bidding contractors on any comparable equivalent product, whether or not the manufacturer of such product is listed herein as an "acceptable manufacturer". Such product bids should clearly indicate offerings that are not listed as "acceptable manufacturers". In the event a bidding contractor, after satisfying himself that such unlisted product is in fact "equal" to the specified product with respect to design, quality, performance and arrangement (space requirements), and the Contractor desires to furnish that product on the Project, he may request the name of the manufacturer be added to the list of acceptable manufacturers as an 'Alternate'.

E. At a bidder's request, an unnamed manufacturer's equipment will be considered to determine additional "acceptable manufacturers" if a request is made in writing no later than six (6) days prior to the bid opening. If such requests are found acceptable, an addendum will be written listing additional acceptable manufacturers. Consideration will be given only to requests of bonafide bidders (contractors), not to those received from vendors.

F. Manufacturers of materials and equipment shall be as specified, scheduled, or as listed in each respective product Specification Article.

2.4 SIGNAGE AND IDENTIFICATION EQUIPMENT

A. Identify electrical equipment with nameplate bearing equipment name and number, using bevel edges, 1/16-inch thick, 1-1/2-inch black laminated bakelite with engraved white letters, 1/2-inch (double line) or 7/8-inch (single line) high, permanently mounted on the equipment in a conspicuous place with screws. Cardholders with card identification will not be accepted.

B. Underground Warning Tapes For Buried Lines-

1. Provide 3-inch wide metallic core brightly colored polyethylene detection tape, shallow buried in the trench above non-metallic conduits, serving the dual purpose of line location and identification. The tape shall be easily detected by any commonly used metal detector and shall bear a printed message (continuous along entire length) describing the contents of the line beneath.

2. Provide 6-inch wide brightly colored polyethylene tape, shallow buried in the trench above metallic conduits, to identify the contents of the line beneath. The tape shall bear a printed message (continuous along entire length) describing the type of the buried line and its contents.

C. Panel boards/Switchboards - Provide nameplates to identify each section as specified for electrical equipment. Type identification cards/panel directory for insertion in cardholder pockets in each lighting and appliance panel board.

D. Miscellaneous:

1. Provide nameplates to identify motor starters, automatic transfer switches, breakers, disconnect switches, time clocks, transformers, and miscellaneous electrical equipment as to systems or mechanical equipment served, source or specific function as appropriate.

E. Nameplates and tags shall correspond to the Record Drawings.

F. Submit complete details of identification legends, color fields, and sizes, coordinated between trades.

G. Provide special signage on breakers and main service equipment as required by the authority having jurisdiction and as shown on the Drawings.

2.5 SLEEVES, INSERTS, ANCHORS AND SUPPORTS

A. Provide in concrete, carpentry or masonry construction, hangers, sleeves, expansion bolts, inserts, supporting steel, or other fixtures necessary for the support of equipment and devices furnished under each Section of the Specifications.

B. Except as otherwise indicated or specified, each conduit, passing through walls, floors, ceilings or partitions shall be provided with sleeves having internal diameters approximately 1-inch larger than the outside diameter of conduit.

C. Sleeves through interior partitions and floors shall be no less than 22 gage-galvanized steel, set flush with the finished surfaces.

D. Sleeves through pre-cast or post-tensioned structures shall be no less than Schedule 40 galvanized steel pipe and shall be subject to the acceptance of the designer of the structure. Submit size, location, and sleeve material for Structural Engineer review and acceptance.

E. Sleeves through grade slabs, basement or exterior wall shall be steel or cast iron conduit with water stop flange, set flush with finished surfaces, and with the space between the pipe and the sleeves packed with oakum or jute twine and caulked watertight.

F. Sleeves in wet or potentially wet floors or spaces such as equipment rooms or sprinkled areas shall be Schedule 40 galvanized steel pipe with water stop flange and with the top of the sleeve projecting 2-inches above the finished floor, with annular space packed with oakum or jute twine and caulked watertight.

G. Option - Provide link-seal neoprene closure fittings in lieu of packing.

H. Attachments to structure shall be by means of beam clamps wherever practicable. Unavoidable attachments to concrete structure shall be by means of pre-set concrete inserts whenever the need for such attachment can be reasonably foreseen and the locations and sizes of inserts is known prior to pouring of concrete. In instances where it is necessary to make attachments to concrete and proper inserts have not been pre-set, the attachment shall be made by means of drilled holes and expansion anchors of either the bolt stud or flush variety. Design working stress of attachments shall be limited to 25 percent of the average maximum (ultimate) stress values published by the manufacturer.

I. Inserts shall be cast iron or galvanized steel individual type, with accommodations for removable nuts and threaded rods up to 3/4-inch diameter, and permitting lateral adjustment.

J. Fasteners in concrete beams shall be sufficiently above the bottom of the beam to clear reinforcing.

K. Expansion anchors shall be zinc and chromate plated for corrosion protection and conform to the dimensional requirements of Federal Specification FF-S-325. Expansion anchors shall be selected and installed in accordance with the recommendations of Expansion Anchor Manufacturer's Institute (EAMI) and the manufacturer's instructions.

2.6 FIRE-STOPPING

A. Seal annular spaces between sleeves and penetrating materials in fire-rated floors, ceilings, and walls with fireproof and waterproof silicone elastomer applied in accordance with the manufacturers published instructions. Multiple penetrations shall be sealed with silicone foam; single penetrations may be sealed with silicone caulking. Seal material shall be UL classified for use in fire-rated penetration seals, and shall be applied in the manufacturer's recommended thickness for the fire rating of the penetrated structure in accordance with ASTM-E-814 requirements.

B. Acceptable Manufacturers: Dow Corning, General Electric, 3M.

2.7 WATERPROOFING

A. Seal penetrations of wet or potentially wet structures, floors, exterior walls, etc., other than those requiring fire stopping, with sealant to prevent moisture leakage. Apply sealing material (caulking) in accordance with manufacturer's published instructions.

B. Product Research and Chemical Co. "Poly-Sulphide Sealant" PRC-5000.

2.8 AUXILIARY STRUCTURAL SUPPORTS

A. Provide auxiliary structural supports as necessary to support electrical systems from the building structure indicated on the structural drawings. Supporting members shall be metal strut framing or standard structural shapes, designed to support imposed loads with a working stress no greater than 25 percent of ultimate stress values of the members, and articulation with the building structure without exceeding structural limitations at the

point of attachment to the building structure. Prepare calculations and Shop Drawings of each such support and submit for approval.

2.9 WIRE AND CABLE

A. General:

1. Wire and cable for feeder and branch circuits shall conform to the requirements of the current edition of the National Electrical Code, and shall meet applicable ASTM specifications. Conductors shall be soft drawn, annealed, 98 percent conductivity copper. Wire and cable shall be new, shall have size, type of insulation, voltage rating and manufacturer's name permanently marked on the outer covering at regular intervals. Conductors No. 8 AWG and smaller shall be color-coded #6 and larger to be marked with phasing tape. Colors for each phase and neutral shall be consistent throughout the system.

B. 600 volt insulation:

1. Provide conductors with insulation rated for 600 volts unless specified or indicated otherwise. System design is based on the following U.S. products:

2. NEC Type THW, XHHW, THWN or THHN solid or stranded for Number 12 AWG or smaller.

3. NEC Type THW, XHHW, THWN or THHN stranded for Number 10 and larger.

4. Plenum Cable: Provide UL listed cables, complying with the requirements of the National Electrical Code, insulated with a UL classified fluoro-polymer material for all cable applications within plenums unless enclosed in conduit. Any cables not enclosed in conduits in such plenums shall have insulation classified as low smoke producing and very low flame spread, such as Teflon FEP or Halon ECTFE, and is UL listed for the specific application.

5. Type MTW for battery and DC power circuits.

6. NEC Type MC: Factory assembled armored cable consisting of one or more insulated conductors with a green insulated conductor used for grounding equipment enclosed in a metallic sheath of interlocking tape, or a smooth or corrugated tape.

a. Conductors shall be copper; NEC Type THHN or XHHW with 90 C. 600 volt rated cross-linked polyethylene insulation.

C. Acceptable Manufacturers: for Wire and Cable: Essex, Okonite, and Southwire.

D. Acceptable Manufacturers for Connectors: Appleton, Blackburn, Bridgeport, Buchanan, Burndy, Ideal, Killark, 3M, O.Z., Penn Union, Thomas & Betts.

2.10 RACEWAYS

A. Metallic conduit and ANSI C80.4 fittings shall be incorporated into the Electrical Work in accordance with the applicable articles of the National Electrical Code.

B. GRC - Galvanized rigid conduit, threaded and coupled steel, ANSI C80.1, UL-6, protected by an overall zinc coating to the inside and outside surfaces of the metal. Coating may be applied by the hot-dip metalizing or sherardizing process.

C. IMC - Intermediate metal conduit, threaded and coupled steel, manufactured in accordance with UL 1242, hot-dip galvanized, installed in accordance with UL general information card DYBY and NEC Article 345, with threaded joints.

D. EMT - Electrical metallic tubing, 'thin wall" zinc coated steel, enameled interior, ANSI C80.3, UL-797, assembled using concrete tight and rain tight cast gland-ring compression threaded insulated throat type fittings for sizes 1-1/4' and smaller. Sizes 1-1/2" and larger can be setscrew type with insulated throat.

E. ENT – Electrical non-metallic tubing.

F. Flex - Flexible steel, UL-1, conduit shall be constructed from interlocking single strip flexible steel tubing, galvanized or sherardized. Connectors shall be galvanized, malleable iron squeeze type, or Tomic twist-in type.

G. Liquid-tight flexible metallic raceway shall be similar to standard flexible steel conduit except encased in liquid tight neoprene outer jacket.

H. PVC - Polyvinyl chloride Schedule 40, NEMA TC2, UL 651, with solvent welded joints.

I. SMR - Surface Metal Raceway - An assembly consisting of base and cover sections, fittings and boxes, constructed of corrosion resistant coated steel with an interior finish to avoid abrasion of electrical conductors, conforming to UL No. 5-1977 and F.S. W-C-582.

J. Acceptable Manufacturers - Walker & Wire mold.

K. Application:

1. Provide electrical metallic tubing (EMT) within structure, except as specified otherwise.
2. EMT connectors - Provide gland ring compression threaded fittings for 1/2" thru 1-1/4". Sizes 1-1/2" and larger shall be setscrew type.
3. Rigid steel conduit (GRC) shall be used in the following locations (except where indicated otherwise):
    a. High voltage raceway.
    b. At or below grade.
    c. In locations where electrical metallic tubing is not permitted and other raceway is not required.
    d. In or beneath slabs on grade.
    e. Hazardous areas as defined by NEC.
    f. Where exposed to physical damage, excessive moisture, rain, etc.
4. Intermediate metal conduit (IMC) may be substituted for GRC for sizes 4-inches and smaller if approved by code authority.
5. PVC may be used:
    a. In or beneath slabs on grade.
    b. In concrete duct banks provide there is 2” spacing with 3" overall coverage.
6. Provide flexible conduit for transformer connections, and at equipment requiring adjustments or removal for service, not subject to moisture.
7. Provide liquid-tight flexible conduit for each motor and rotating device for power and control, computer room and for other equipment requiring adjustments or removal for service in mechanical rooms or where subject to moisture or weather.

8. Non-metallic conduit (and grounding conductor) with rigid steel riser stub-ups may be used for slabs on grade.
9. Conduit and fittings shall be UL listed for the application and location of their intended uses.

L. Acceptable Manufacturers for GRC, IMC, and EMT: Allied, and Triangle & Wheatland.

M. Acceptable Manufacturers for GRC, IMC, and EMT Fittings: AFC, Appleton, Bridgeport, Midwest, Neer, O.Z. Gedney, Raco, and Steel City.

N. Acceptable Manufacturers for flex and liquid-tight flex: American Flex, Alflex, Anaconda, Coleman, Electric-Flex, and International.

O. Acceptable Manufacturers for flex and liquid-tight flex fittings: Appleton, Bridgeport, Berger, Efcor, Electro line, Midwest, Neer, O.Z. Gedney, Raco, and Steel City.

P. Acceptable Manufacturers for PVC and PVC fittings: Cantex, Carlon Certain teed, National, Sedco, and Midwest.

2.11 CABLE FIRESTOPS

A. Seal cable penetrations of fire-rated floors, ceilings, and walls with a fire-rated closure in compliance with NEC 300-21 and UL 1479. Closures shall be rated as per ASTM-E-1 19 three-hour fire rating and hose test and shall consist of grouted-in metal frame sized for applicable fill per NEC, and sealing block assemblies of elastomeric material sized to fit the cables or conduits entering the fire barrier. The elastomeric material shall expand during fire to seal any voids left by burning cable insulation.

B. Install closures in accordance with manufacturer's recommendations.

C. Acceptable Manufacturers: Crouse-Hinds, Nelson, 3M, Dow Corning, General Electric, and International Protective Coatings.

2.12 FLASHINGS

A. Provide weatherproof flashings for openings through the roof related to electrical systems.

B. Flashings for conduits shall be constructed from 20 gage galvanized steel sheets, with a base extending ten (10) inches in each direction beyond the exterior surface of the opening to be flashed.

C. Flashings shall be constructed to terminate not less than twelve (12) inches above the roof with suitable counter flashing constructed from the same material as the flashing.

D. Furnish flashings for curbs related to electrical system. Furnish and install counter flashing at each curb.

2.13 HANGERS AND SUPPORTS

A. All free standing equipment shall be braced and anchored to the floor. Secure equipment using stainless steel anchor bolts in accordance with the manufacturer’s instructions..

B. Conduits: Support securely from the structure with rigid steel supports. Provide necessary channels, hanger rods, bolts, nuts, locknuts, accessories and devices to provide a complete structural system. The system shall allow free expansion and contraction.

C. Panel boards, disconnects, starters, cabinets, pull and junction boxes, etc. Provide channel supports and miscellaneous steel angles to rigidly support equipment from the structure

where required by special conditions and where vertical and/or horizontal support is required other than that provided in the structure.

D. Structural support systems shall be specifically designated as suitable for electrical installations. Bases, dimensions and sizes are to be as required for application, job conditions, loads imposed and manufacturer's recommendations.

E. Channels: Provide continuous slotted channel, #12 gage steel (minimum). Fasten conduits to channels with pipe channel straps.

F. Hanger Rods: Provide steel rods with continuous, free running threads.

G. Straps, Pipe and Conduit Hangers, Inserts, Clamps, Accessories and Devices Provide malleable iron or formed steel, as applicable.

H. Flexible cable, strap or wire hangers and fasteners will not be accepted.

I. Steel and malleable iron shall be zinc chromate electro galvanized.

J. Attachments to Structure - Fastenings to wood shall be by wood screws or screw type nails. Fastenings to hollow masonry units shall be by toggle bolts. Fastenings to concrete or brick shall be by preset inserts or expansion bolts. Fastenings to steel shall be by machine screws, bolts (with flat washers and lock washers), and welded threaded studs or beam clamps designed for the application. Wood plugs and gun fired power driven fasteners will not be accepted.

K. Fasten single runs of conduit directly to the structure or hang on rod hangers with one or two hole pipe straps, "U" bolts, lay-in pipe hangers, conduit and pipe hangers, beam clamps and angle clamps as appropriate.

L. Fasten multiple runs of conduit directly to the structure using continuous channel inserts or continuous surface channels. Trapeze hangers utilizing channels and rod hangers may also be used.

M. Conduit shall be securely fastened within three feet of each outlet or junction box, fitting, cabinet or panel board. Conduit shall be fastened at intervals not to exceed ten (10) feet.

N. Provide riser clamps at floor lines for vertical runs of conduit.

O. Conduits and Raceways with Expansion Joints: Install supports to allow equally distributed expansion and contraction. Use guides, saddles, "U" bolts and/or anchors designated for this application.

P. Cables and Wires in Manholes, Cable Chambers, Cable Chases and Other Locations: Provide hangers, racks, cable cleats and supports designated for the application to insure a neat and secure installation.

Q. Structural support systems, channels, hanger rods, bolts, nuts and accessory items shall be as manufactured by Unistrut or approved equal.

R. All supports shall be directly connected to basic structural elements of the building or site work. Electrical support systems shall be independent of other systems (HVAC, plumbing, suspended ceilings, raised floors, etc.). Support systems may be shared with similar wire way and conduit systems (fire alarm, security, MATV, etc.).

2.14 FUSES

A. SUMMARY

1. This Section includes the following:

a. Fuses

B. QUALITY ASSURANCE

1. Source Limitations: Obtain fuses from one source and by a single manufacturer.
2. Comply with NFPA 70 for components and installation.
3. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.
    a. The Terms “Listed” and “Labeled”: As defined in the National Electrical Code, Article 100.

C. EXTRA MATERIALS

1. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
    a. Spare Fuses: Furnish quantity equal to 20 percent of each fuse type and size installed, but not less than 1 set of 3 of each type and size.

D. MANUFACTURERS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fuses that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide fuses by one of the following:
    a. Cooper Industries Inc.; Bussmann Div.
    b. Eagle Electric Mfg. Co., Inc.
    c. General Electric Co.; Wiring Devices Div.
    d. Gould Shawmut.

2.15 GROUNDING AND BONDING

A. Rods: Ten (10) feet long, 3/4-inch diameter copper weld rods or as indicated on the drawings.

B. Conductor: Sized no smaller than the following:

1. The size noted on the drawings or otherwise scheduled.
2. The size of the phase conductors in the feeder or branch circuit.
3. The sizes required by Article 250 of the National Electrical Code.

C. Compression Grounding Connectors: Provide Hyground compression system as manufactured by Burndy. Each connector shall have the die index number embossed on application.

D. Grounding connectors shall meet the test requirements of IEEE Standard 837-2002 and shall be exothermic type.

E. All ground conductors shall be copper, and unless specifically noted otherwise, shall be provided with Type THW or THWN, 600-volt insulation.

F. All ground electrode conductors shall be bare copper, sized in accordance with Article 250 of the National Electric Code.

G. Ground busses required for the interconnection of grounding conductors shall be solid copper bars, rigidly supported by metal framework and insulated from the building structure.

H. Conductors shall be supported independently and rigidly attached to the building structure. Attach conductors to the buss with compression type lugs.

2.16 WIREWAYS, PULL AND JUNCTION BOXES

A. Provide wire way, junction and pull boxes indicated and at locations required by the National Electrical Code, and at those locations required to facilitate the pulling of wire, fabricated in accordance with NEMA and National Electrical Code requirements with respect to material, gages, dimensions and methods of fastening. Wire way, junction and pull boxes shall bear the UL label and shall be listed for the application and location of their intended use. Units shall be finished in standard gray enamel, sides and backs spot welded in position, and removable screw cover.

B. Construct wire way and accessories in accordance with UL 870, with hinged, removable, sealable covers, arranged for lay-in conductor installation. Connectors shall be slip-in arrangement with captive mounting screws. Arrange hangers in a "J" configuration to allow conductor lay-in from one side.

C. Interior boxes shall be stamped or fabricated galvanized steel.

D. Exterior boxes not totally protected from exposure to driving rain or from excessive moisture shall be PVC or hot-dip galvanized cast iron, complete with threaded hubs, bolted weatherproof covers, and rubber or neoprene gaskets.

E. Grade level exterior boxes shall be PVC or cast iron with solid covers secured with rubber gaskets and bronze cap screws. Conduit connections shall be drilled and tapped for threaded

F. Construct exterior concrete boxes as detailed with solid cast iron covers secured with rubber gaskets and bronze cap screws.

G. Conduits entering boxes shall be through tight-fitting bored or punched holes, or threaded hubs, and shall be secured firmly.

H. Covers in finished areas shall have prime coat.

I. The volume of the boxes shall be in accordance with the NEC requirements, but shall be no smaller than four (4) inches square in any case.

J. Boxes shall be accessible at job completion. Boxes with covers in finished areas shall be in those physical locations approved by the Architect.

K. Acceptable Manufacturers: Carlon, Circle AW, Hoffman, and Neenah.

2.17 OUTLET BOXES AND ACCESSORIES

A. Interior boxes: Standard, single or multiple gang stamped galvanized steel boxes, of the proper size to accommodate the device and function for which intended, complete with extension or plaster rings where required. Boxes for mounting of surface lighting fixtures shall be 4-inch octagon boxes, with 3/8-inch no-bolt fixture studs used to securely support fixture. Provide proper covers or device plates.

B. Exterior boxes: Hot-dip galvanized cast iron, complete with threaded hubs, bolted weatherproof covers, and rubber or neoprene gaskets.

C. Concrete boxes: Outlet boxes in concrete slabs shall be two-piece concrete boxes not less than 4-inch nominal size with a minimum depth of 2-1/2-inches. If used for lighting fixtures, outlet boxes shall be equipped with fixture stud.

D. Waterproof boxes: Conduit boxes of cast or metal threaded hub type with suitable gasket covers shall be used where waterproof boxes are required.

E. Flush type floor boxes: Fully adjustable (before and after concrete pour), cast iron for slabs on grade, stamped steel for slabs above grade, with surface flush ring finish to match wiring devices and coverlets specified, with waterproof threaded outlets, sized and arranged to receive devices scheduled.

F. Acceptable Manufacturers: Appleton, Adult, Bell, Bowers, Crouse Hinds, Killark, O.A Gedney, Raco, Red Dot, and Steel City.

2.18 WIRING DEVICES

A. Install on each and every outlet box, a wiring device and cover plate, as indicated by symbol on the Drawings. Manufacturer's model numbers are not intended to indicate color of devices. Color of devices is designated under "Device Plates". Toggle switches shall be quiet, ac type, and specification grade, listed by Underwriters Laboratories, Inc., and meeting the requirements of NEMA Standard WD-1-1971. Back or side screw terminal shall accommodate up to 10 AWG solid or stranded conductors. Contacts shall be rated at 20 amperes, 120/277 volts ac only, single pole, 3-way, 4-way, or key-operated as indicated.

B. Each pilot light shall be installed as a separate device, using a multi-gang box and switch plate when combined with another device. Lamp holders shall be of the strap type, with flush neon pilot light having red jewel.

C. General purpose single and duplex receptacles: shall be specification grade rated 125 volts, two-pole, three-wire, grounding type with polarized parallel slots, Style S Series, in accordance with Federal Specification W-C-596, and listed by Underwriters Laboratories, Inc., in accordance with NEMA Standard Publication WD-1, paragraph 3.02. Bodies shall be of phenolic compound supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side or-back wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke.

D. NEMA Configurations

1. 2 Pole, 3 Wire, Grounding, 125V, Non-Locking
    a. 20 Ampere – NEMA 5-20R
    b. 30 Ampere – NEMA 5-30R
    c. 50 Ampere – NEMA 5-50R
2. 2 Pole, 3 Wire, Grounding, 125V, Locking
    a. 20 Ampere – NEMA L5-20R
    b. 30 Ampere – NEMA L5-30R
    c. 50 Ampere – NEMA L5-50R
3. 2 Pole, 3 Wire, Grounding, 277V, Non-Locking
    a. 20 Ampere – NEMA 7-20R
    b. 30 Ampere – NEMA 7-30R
    c. 50 Ampere – NEMA 7-50R
4. 2 Pole, 3 Wire, Grounding, 277V, Locking

a. 20 Ampere – NEMA L7-20R

b. 30 Ampere – NEMA L7-30R

c. 50 Ampere – NEMA L7-50R

5. 3 Pole, 4 Wire, Grounding, 125/250V, Non-Locking

a. 20 Ampere – NEMA 14-20R

b. 30 Ampere – NEMA 14-30R

c. 50 Ampere – NEMA 14-50R

6. 3 Pole, 4 Wire, Grounding, 125V, Locking

a. 20 Ampere – NEMA L14-20R

b. 30 Ampere – NEMA L14-30R

E. Device Plates:

1. Provide one-piece coverlets with rounded edges for outlets and fittings to suit the devices installed. Screws shall have countersunk heads, provided in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices; plaster fillings will not be permitted. Plates shall be installed with an alignment (plumb) tolerance of 1/1 6-inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed.

2. Provide smooth zinc finish cast metal or sheet steel plates with ivory color devices in:

a. Unfinished walls.

b. Equipment rooms.

3. Exterior coverlets - Provide Type 302 stainless steel weatherproof plates with spring-hinged cover and PVC plate and cover gaskets with ivory color devices.

4. Provide nylon plastic or stainless steel plates (as chosen by the architect) with matching color devices in all areas unless noted otherwise. Color/finish to be selected by the Architect.

F. Finish color shall be selected by the Architect.

G. Acceptable Manufacturers: Hubbell, Bryant, Pass & Seymor, Leviton, and Cooper Wiring Devices.

2.19 SURGE PROTECTION DEVICES (TVSS)

A. Description: This section describes the materials and installation requirements for integrated surge protection devices (SPD) in switchboards, panelboards, and motor control centers.

B. Approved Vendors: Square D, Siemens or Eaton.

C. Integral Surge Suppressor

1. SPD shall be Listed and Component Recognized in accordance with UL 1449 Second Edition to include Section 37.3 highest fault current category. SPD shall be UL 1283 listed.

2. SPD shall be installed by and shipped from the electrical distribution equipment manufacturer’s factory.

3. SPD shall provide surge current diversion paths for all modes of protection; L-N, L-G, N-G in WYE systems, and L-L, L-G in DELTA systems.
4. SPD shall be modular in design. SPD for service entrance application shall provide two modules per phase for redundant protection. Each mode including N-G shall be fused with a 200kAIC UL recognized surge rated fuse and incorporate a thermal cutout device.
5. Audible diagnostic monitoring shall be by way of audible alarm. This alarm shall activate upon a fault condition. An alarm on/off switch shall be provided to silence the alarm. An alarm push to test switch shall be provided.
6. If a dedicated breaker for the SPD is not provided, the SPD shall include a UL recognized disconnect switch. A dedicated breaker shall serve as a means of disconnect for distribution SPDs.
7. SPD shall meet or exceed the following criteria:
   a. Minimum surge current capability (single pulse rated) per phase shall be:
      1. Service entrance switchboard: 240kA per phase
      2. Panelboard/MCC locations: 160kA per phase
   b. UL 1449 Suppression Voltage Ratings:
   c.

VOLTAGE	LOCATION	L-N	L-G	N-G
240/120V	Service Entrance:	330V	330V	330V
	Distribution:	330V	330V	330V

8. SPD shall have a minimum EMI/RFI filtering of –50dB at 100 kHz with an insertion ratio of 50:1 using MIL-STD-220A methodology.
9. SPD shall be provided with one set of NO/NC dry contacts.
10. SPD shall have a warranty for a period of five years, incorporating unlimited replacement of suppressor parts. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

2.20 DISCONNECT SWITCHES

A. This section specifies the furnishing, installation and connection of low voltage disconnect switches.

B. APPLICABLE PUBLICATIONS

1. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. The publications below shall be the latest approved version.
2. National Fire Protection Association (NFPA):

   70 National Electrical Code (NEC)

3. Underwriters Laboratories, Inc. (UL):

   98 Enclosed and Dead-Front Switches

248	Low Voltage Fuses
977	Fused Power-Circuit Devices

C. LOW VOLTAGE FUSIBLE SWITCHES RATED 600 AMPERES AND LESS

1. Shall be quick-make, quick-break type in accordance with UL 98, NEMA KS 1 and NEC.
2. Shall have a minimum duty rating, NEMA classification Heavy Duty (HD) for system voltage.
3. Shall be horsepower rated.
    a. Shall have the following features:
    b. Switch mechanism shall be the quick-make, quick-break type.
    c. Copper blades, visible in the OFF position.
    d. An arc chute for each pole.
    e. External operating handle shall indicate ON and OFF position and shall have lock-open padlocking provisions.
    f. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable by a special tool to permit inspection.
    g. Fuse holders for the sizes and types of fuses specified.
    h. Electrically operated.
    i. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
    j. Ground Lugs: One for each ground conductor.
    k. Enclosures:
        1. Shall be the NEMA types shown on the drawings for the switches.
        2. Where the types of switch enclosures are not shown, they shall be the NEMA types which are most suitable for the environmental conditions where the switches are being installed.
        3. Shall be finished with manufacturer’s standard gray baked enamel paint over pretreated steel (for the type of enclosure required).

D. LOW VOLTAGE UNFUSED SWITCHES RATED 600 AMPERES AND LESS

1. Shall be the same as Low Voltage Fusible Switches Rated 600 Amperes and Less, except it shall not accept fuses.

E. MOTOR RATED TOGGLE SWITCHES

1. Refer to appropriate section for motor rated toggle switches.

F. IDENTIFICATION SIGNS

1. Install nameplate identification signs on each disconnect switch to identify the equipment controlled.
2. Nameplates shall be laminated black phenolic resin with a white core, with engraved lettering, a minimum of 6 mm (1/4-inch) high. Secure nameplates with screws.

2.21 LIGHTING AND APPLIANCE PANELBOARDS

A. References:

1. The panelboards and protection devices in this specification are designed and manufactured according to latest revision of the following standards (unless otherwise noted).
2. ANSI 61
3. ANSI/NEMA KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts)
4. ANSI/NEMA PB 1, Panelboards
5. ANSI/NFPA 70, National Electrical Code
6. ASTM - American Society of Testing Materials
7. CSA C22.2 No. 29, Panelboards and Enclosed Panelboards
8. CSA C22.2 No. 5.1, Molded Case Circuit Breakers
9. Federal Specification W-C-375, Rev. B, Amend. 1, Circuit Breakers, Molded Case; Branch Circuit and Service
10. Federal Specification W-P 115, Rev. C, Panel, Power Distribution
11. NEMA AB 1, Molded Case Circuit Breakers and Molded Case Switches
12. NEMA PB 1.1, General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
13. UL 489, Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
14. UL 50, Enclosures for Electrical Equipment
15. UL 67, Panelboards
16. UL 943, Ground-Fault Circuit-Interrupters.

B. Definitions:

1. Overcurrent Protective Device: a circuit breaker pole or single fuse. Example: a 2-pole device is considered 2 protective devices.

C. System Description:

1. Short circuit rating of panelboards shall be the interrupting rating of lowest rated device in the panel or applicable UL series rating for proper main and branch device combinations.
2. Panelboards shall have a maximum of 42 protective devices per panel, including sub-feeders and excluding main overcurrent protective devices. For more than 42 devices, 2 or more panelboards are required.
3. With 2 or more panelboards, sub-feed lug or thru-feed lugs shall be used in all but 1 section of each panelboard. Lugs shall have same capacity as incoming mains. Cable inter-connections shall be field installed.
4. Protective devices shall be molded case circuit breakers.

D. Submittals:

1. Manufacturer shall provide copies of following documents to owner for review and evaluation in accordance with general requirements of Division 1 and Division 16:
2. Product Data on specified product;
3. Shop Drawings on specified product;
4. Certified trip curves for each specified product;

E. Project Record Documents:

1. Maintain an up-to-date set of Contract documents. Note any and all revisions and deviations that are made during the course of the project.

F. Operation and Maintenance Data:

1. Manufacturer shall provide copies of installation, operation and maintenance procedures to owner in accordance with general requirements of Division 1 and Division 16.
2. Submit operation and maintenance data based on factory and field testing, operation and maintenance of specified product.

G. Quality Assurance (Qualifications):

1. Manufacturer shall have specialized in the manufacture and assembly of lighting and appliance panelboards for 50 years.
2. Lighting and appliance panelboards shall be listed and/or classified by Underwriters Laboratories in accordance with standards listed in Article 1.03 of this specification.
3. Installer has specialized in installing lighting and appliance panelboards with minimum 5 years documented experience.

H. Delivery, Storage, and Handling:

1. Deliver, store, protect, and handle products in accordance with recommended practices in manufacturer's Installation and Maintenance Manuals.
2. Deliver each lighting panelboard in individual shipping cases for ease of handling. Each panelboard shall be wrapped for protection.
3. Inspect and report concealed damage to carrier within specified time.
4. Store in a clean, dry space. Maintain factory protection or cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. (Heat enclosures to prevent condensation.)
5. Handle in accordance with NEMA and manufacturer's written instructions to avoid damaging equipment, installed devices, and finish.

I. Project Conditions (Site Environmental Conditions):

1. Follow (standards) service conditions before, during and after panelboard installation.
2. Lighting and appliance panelboards shall be located in well-ventilated areas, free from excess humidity, dust and dirt and away from hazardous materials. Ambient temperature of area will be between minus 30 and plus 40 degrees C. Indoor locations shall be protected to prevent moisture from entering enclosure.

J. Warranty:

1. Manufacturer warrants equipment to be free from defects in materials and workmanship for 1 year from date of installation or 18 months from date of purchase, whichever occurs first.

K. Maintenance Service:

1. Furnish complete service and maintenance of lighting and appliance panelboards for 1 year from date of substantial completion.

L. Extra Materials:

1. Provide parts/spares as indicated in drawings.

M. Field Measurements:

1. Make all necessary field measurements to verify that equipment shall fit in allocated space in full compliance with minimum required clearances specified in National Electrical Code.

N. Manufacturer:

1. Siemens products have been used as the basis for design. Other manufacturers' products of equivalent quality, dimensions and operating features may be acceptable, at the Engineer's discretion, if they comply with all requirements specified or indicated in these Contract documents.

O. Components:

1. Refer to Drawings for: actual layout and location of equipment and components; current ratings of devices, bus bars, and components; voltage ratings of devices, components and assemblies; and other required details.

P. Ratings:

1. Lighting and appliance panelboards shall be rated as indicated in drawings.
2. Maximum current ratings for mains, sub-feeds and branches, respectively, shall be specified in drawings.

Q. Enclosure:

1. Boxes shall be a nominal 20 inches wide and 6 inches deep with wire bending space per National Electric Code.
2. Fronts shall be reinforced steel with concealed hinges and concealed trim adjusting screws. Trim clamps are unacceptable.
3. All door locks shall be corrosion proof Valox (or equal) with retractable latches. All door locks shall be keyed for a single key.
4. Clear Lexan (or equal) directory card holders shall be permanently mounted on front door.
5. All panelboard series ratings shall be prominently displayed on dead front shield.
6. Interiors shall permit top or bottom incoming cables.
7. Panels shall be “door within a door” type construction.

R. Bus bars:

1. Bus bars shall be phase sequenced, fully insulated and supported by high impact Noryl (or equal) interior base assemblies.

2. Bus bars shall be mechanically supported by zinc finished galvanneal steel frames to prevent vibration and damage from short circuits.
3. Terminations shall be UL tested and listed and suitable for UL copper wire.
4. Provide 1 aluminum bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors for bolt-on branch circuit breakers. Bus bars shall be rated as indicated in drawings.
5. Split solid neutral bus shall be plated and located in main compartment for all incoming neutral cables to be same length.
6. Lugs shall be rated for 75 degree C terminations.
7. Main lugs for conductors shall be compression lugs. Lug bodies shall bolt in place.

S. Circuit Breakers:

1. Molded case circuit breakers shall be bolt-on devices.
2. All circuit breakers shall have thermal and magnetic trip elements in each pole.
3. 2 and 3 pole breakers shall have internal common trip crossbars for simultaneous tripping of each pole.
4. Circuit breakers shall not be restricted to any mounting location due to physical size.
5. All branch breakers 15 to 100 amperes shall be able to be mounted in any panel position
6. Main and sub-feed circuit breakers may be vertically or horizontally mounted.
7. Branch breaker panelboard connections shall be copper to copper.
8. All panelboard terminations shall be rated as indicated in drawings.
9. All breakers shall have an over center mechanism and be quick make and quick break.
10. All breakers shall have handle trip indication and a trip indicator in window of circuit breaker housing.
11. Breaker handle and faceplate shall indicate rated ampacity.
12. Circuit breaker escutcheon shall have standard ON/OFF markings.
13. Main breakers shall be UL listed for use with: Shunt, Under Voltage, and Ground Fault Shunt Trips; Auxiliary and Alarm Switches; and Mechanical Lug Kits.
14. Branch breakers shall be UL listed for use with: Shunt Trips, Auxiliary and Alarm Switches.

T. Accessories:

1. Contactor control relays
2. Tork (or equal) time clocks
3. Locking devices for breakers and operating handles.
4. Furnish nameplates for each device as indicated in drawings. Color schemes shall be as indicated on drawings.

U. Finish:

1. Boxes shall be corrosion resistant, zinc finish galvanneal.
2. Fronts shall be powder finish painted ANSI 61 gray.

V. Examination:

1. Verify that panelboards are ready to install.
2. Verify field measurements are as instructed by manufacturer.
3. Verify that required utilities are available, in proper location and ready for use.
4. Beginning of installation means installer accepts conditions.

W. Installation:

1. Additional provisions and editing may be required for this part.
2. Install per manufacturer's instructions.
3. Install required safety labels.

X. Field Quality Control:

1. Inspect installed panelboards for anchoring, alignment, grounding and physical damage.
2. Check tightness of all accessible mechanical and electrical connections with calibrated torque wrench. Minimum acceptable values are specified in manufacturer's instructions.
3. Test each key interlock system for proper functioning.

Y. Adjusting:

1. Adjust all circuit breakers, access doors, operating handles for free mechanical and/or electrical operation as described in manufacturer's instructions.

Z. Cleaning:

1. Clean interiors of panels to remove construction debris, dirt, shipping materials. Repaint scratched or marred exterior surfaces to match original finish.

2.22 POWER PANELBOARDS

A. References:

1. The low voltage power panelboards and protection devices in this specification are designed and manufactured according to latest revision of the following standards (unless otherwise noted).
2. ANSI/NEMA PB 1, Panelboards
3. ANSI/NFPA 70, National Electrical Code
4. Federal Specification W-C-375, Rev. B, Amend. 1, Circuit Breakers, Molded Case; Branch Circuit and Service
5. Federal Specification W-P 115, Rev. C, Panel, Power Distribution
6. Federal Specification W-S-865 - Heavy Duty Switches
7. UL 489, Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
8. UL 50, Enclosures for Electrical Equipment

9. UL 67, Panelboards
10. UL 98, Enclosed and Dead Front Switches

B. Definitions:

1. Overcurrent Protective Device - Single pole circuit breaker. Example: A 2-pole device is considered 2 protective devices.

C. System Description:

1. Equipment shall be indoor deadfront power panelboards for molded-case circuit breakers.
2. Panelboards shall meet service entrance requirements when specified.
3. Panelboards shall have integrated short circuit rating. Fully rated panel rating is that of lowest rated device in panelboard. Series rating are for the UL tested main-branch combination.

D. Submittals:

1. Manufacturer shall provide copies of following documents to owner for review and evaluation in accordance with general requirements of Division 1 and Division 16:
2. Product Data on specified product;
3. Shop Drawings on specified product;
4. Trip curves for each specified product;

E. Installation, Operation, and Maintenance Data:

1. Manufacturer shall provide copies of installation, operation and maintenance procedures to owner in accordance with general requirements of Division 1 and Division 16.

F. Quality Assurance (Qualifications):

1. Manufacturer shall have specialized in the manufacture and assembly of low voltage power panelboards for 25 years.
2. Low voltage power panelboards shall be listed and/or classified by Underwriters Laboratories in accordance with standards listed in Section 2.30, A of this specification.

G. Delivery, Storage, And Handling:

1. Contractor shall deliver, store, protect, and handle products in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals.
2. Ship each low voltage power panelboard section in individual shipping splits for ease of handling. Each panelboard section shall be mounted on shipping skids and wrapped for protection.
3. Contractor shall inspect and report concealed damage to carrier within specified time.
4. Contractor shall store in a clean, dry space. Maintain factory protection or cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic.
5. Contractor shall handle in accordance with manufacturer's written instructions to avoid damaging equipment, installed devices, and finish.

H. Project Conditions (Site Environmental Conditions):

1. Low voltage power panelboards shall be located in well-ventilated areas, free from excess humidity, dust and dirt and away from hazardous materials. Ambient temperature of area will be between minus 30 and plus 25 degrees C. Indoor locations shall be protected to prevent moisture from entering enclosure.

I. Warranty:

1. Manufacturer warrants equipment to be free from defects in materials and workmanship for 1 year from date of installation or 18 months from date of purchase, whichever occurs first.

J. Field Measurements:

1. Contractor shall make all necessary field measurements to verify that equipment shall fit in allocated space in full compliance with minimum required clearances specified in National Electrical Code.

K. Manufacturer:

1. Siemens Company products have been used as the basis for design. Other manufacturers' products of equivalent quality, dimensions and operating features may be acceptable, at the Engineer's discretion, if they comply with all requirements specified or indicated in these Contract documents.

L. Components:

1. Refer to Drawings for: actual layout and location of equipment and components; current ratings of devices, bus bars, and components; voltage ratings of devices, components and assemblies; and other required details.

M. Enclosures:

1. Panel box shall be galvanized code gauge sheet steel with removable end walls.
2. Enclosures shall be surface mounted.
3. Enclosures shall be NEMA type per intended location.

N. Fronts:

1. Provide a four-piece front to cover wiring gutter and wiring access areas. Provide a lockable hinged door with semi-concealed hinges to cover access to circuit breakers.
2. Hinged door fronts, when specified, shall be provided with door-in-door. An inner door shall cover the circuit protective devices and shall be able to be locked.
3. Door locks shall be GE Valox style.

O. Interiors:

1. Panelboard interior shall be designed and assembled such that circuit protective devices shall be solidly connected to the distribution panel vertical bus. The bus bars shall be attached to the feeder device by bolts and to the vertical bus by bolts and anti-turn methods.
2. Circuit breaker connectors shall be designed so that circuit breakers may be removed without disturbing adjacent devices.
3. Panelboards shall be rated as indicated in drawings. Main devices shall have maximum rating of 1200 amperes.

4. Panelboards shall have three vertically aligned bus bars.
5. Bus bars shall be aluminum. The bus bars shall have sufficient cross sectional area to meet UL 67 temperature rise requirements through actual tests. The bus bars shall be standard density rated for 1000 amperes per square inch. Bus bars shall be phase-sequenced and rigidly supported by high impact resistant, insulated bus supporting assemblies to prevent vibration or short circuit mechanical damage.
6. Neutral bus shall be fully rated.
7. All solderless terminations shall be suitable for copper UL listed wire or cable and shall be tested and listed in conjunction with appropriate UL standards. Terminations shall be rated for use with conductor ampacity as assigned in the NEC 75 degree C table.
8. Ground wire terminations shall be provided as an optional kit for installation by panelboard installer without voiding UL label.

P. Main and Branch Devices:

1. Circuit breakers:
2. Main and branch circuit breakers shall be quick-make, quick break, and trip indicating, low voltage molded-case (or equal).
3. Circuit breaker case shall have ON/OFF and International I/O position indicators.
4. Breaker faceplate shall list current rating, UL and IEC certification standards, and AIC ratings.
5. Circuit breakers shall be factory sealed and shall be date coded on breaker case.
6. Breakers shall be UL listed for reverse connection without restrictive line or load markings. Circuit breakers shall be able to mount in any operating position.
7. 3-pole breakers with ampere ratings greater than 150 ampere shall have interchangeable rating plugs.
8. Interrupting rating of breakers shall not be less than maximum short circuit current available at incoming line terminals.
9. Breakers shall have UL listing.
10. Main breakers and lugs shall be convertible by installer for top or bottom incoming feed.
11. Where indicated on the drawings,} the main breaker shall be provided with integral ground fault pick-up and delay settings and adjustable long time settings.

Q. Accessories:

1. Provide through-feed lugs for panels rated 200 Amperes and above.
2. Padlocks
3. Grounding bars. (Neutral bus shall have grounding lug for Service Entrance applications.)
4. Exterior mounted equipment label
5. Furnish nameplates for each device as indicated in drawings. Color schemes shall be as indicated on drawings.

R. Finish:

1. Standard panelboard boxes shall be galvanealed (zinc finished) or galvanized.
2. Fronts shall be coated with phosphatized rust inhibitor and finish coated with ANSI 61 light gray baked on powder coat.
3. Screw fasteners shall be zinc coated to retard corrosion.

S. Examination:

1. The following procedure shall be performed by the contractor:
2. Verify that low voltage panelboards are ready to install.
3. Verify field measurements are as shown on Drawings.
4. Verify that required utilities are available, in proper location and ready for use.
5. Beginning of installation means installer accepts conditions.

T. Installation:

1. Contractor shall install per manufacturer's instructions.
2. Contractor shall install required safety labels.

U. Adjusting:

1. Adjust all circuit breakers, switches, access doors, operating handles for free mechanical and electrical operation as described in manufacturer's instructions.
2. Adjust circuit breaker trip and time delay settings for proper operation of all electrical systems and devices.

V. Cleaning:

1. Clean interiors of switchboards, panels, separate enclosures to remove construction debris, dirt, shipping materials.
2. Repaint scratched or marred exterior surfaces to match original finish.

2.23 SHORT CIRCUIT RATINGS

A. It shall be the responsibility of the electrical contractor and equipment manufacturer to supply devices rated for the available fault current.

B. Electrical equipment, circuit protective devices, bussing, and switches shall be rated to interrupt or withstand short circuit faults greater than the available fault current.

2.24 INTERIOR LIGHTING

A. Furnish, install and wire lighting fixtures scheduled or indicated by type designation on the Drawings. If type designation is omitted, fixtures shall be of the same type as shown for rooms of similar usage. Verify before purchase and installation.

B. Locations of fixtures on Electrical Drawings are diagrammatic. Verify location and spacing with architectural reflected ceiling plans and other reference data before installation. Coordinate space conditions, including head room clearances, and interference's with ceiling components, such as ducts, openings, beams and piping, prior to installation.

C. Check the architectural finishes, and regardless of the catalog prefixes and suffixes shown, furnish fixtures with the proper trim, frames, supports, hangers and other

miscellaneous appurtenances to properly coordinate with said finishes. Where required, furnish reinforcing for ceiling construction to support weight of fixtures.

D. Fixtures shall be free of light leaks and designed to provide sufficient ventilation of lamps and ballasts, including vent holes where required. Outdoor fixtures with vent holes shall have wire mesh screens in the vent holes.

E. Wiring channels and socket mountings shall be rigid and accurately made. Sockets shall hold lamps securely against normal vibration and maintenance handling. Provide silver plated contacts in sockets for mogul base incandescent, metallic vapor and mercury vapor lamps, in all outdoor fixtures, and tungsten halogen lamps.

F. Housing shall be National Electrical Code gage, bonderized steel or equal rust protection, rigid constructions, baked-on enamel finish, color as selected by Architect. Fluorescent housings shall be suitable for continuous row mounting where indicated. Incandescent housings shall have matte black finish on concealed surfaces, and all fixtures shall be prewired.

G. Reflectors shall have no less than 85 percent reflectance.

H. Light shields and lens shall be as specified under individual fixture types but lens thickness shall be no less than 0.125-inches, shall weigh not less than eight ounces per square foot, manufactured from 100% virgin acrylic.

I. Fixtures a scheduled by manufacture's names and catalog numbers are fixtures which will be acceptable. Fixtures of other manufacture, if similar and equal (with respect to quality of materials, components, construction, light distribution characteristics and physical size, shape and appearance) to those scheduled, will be considered as substitutions for the scheduled fixtures, subject to approval of submittal data (and sample, if required).

J. Submit shop Drawings or catalog cuts for each type of fixture specified or noted. Drawings shall indicate fixture type, complete details of fixtures, including manufactures catalog numbers for sockets, ballasts, light shields, metal gages, type of wiring, color and texture of finish. Submit samples of finish and ETL curves (photometric data) when required. Submit fixture sample as specified.

K. All fixtures installed in rated ceilings or ceilings with insulation are to have protective boxes maintaining the rating of the ceiling or being IC rated.

L. Acceptable manufacturers: Any listed manufacturer conforming to Specifications.

2.25 LAMPS

A. Provide lamps for all fixtures. Lamps on the project shall be new, delivered to the job site in original packing cases and sleeves, and shall be of the same manufacture.

B. Acceptable manufacturers: General Electric, North American Phillips, Osram/Sylvania

C. Install lamps in fixtures prior to energizing and replace burned out lamps up to the day building is accepted for occupancy.

2.26 EXTERIOR LIGHTING

A. Exact aiming of floodlighting and accent lighting is not shown, but shall be determined at the job site. Arrange for trial aiming at night as directed by the Architect. Fixtures shall be powered prior to trial aiming, complete approval of aiming procedure obtained in writing after trial but prior to final aiming, and fixtures finally aimed in accordance with approved procedure.

3 EXECUTION

3.1 GENERAL PROVISIONS FOR ELECTRICAL WORK

A. EXECUTION OF WORK

1. Install all materials and equipment in a neat and workmanlike manner and provide for the following:
   a. All work shall be installed so as to be readily accessible for operation, maintenance and repair. Minor deviations from the plans may be made to accomplish this, subject to the approval of the Engineer.
   b. The area of work shall be kept free of litter and debris. Contractor shall clean up the work area at the end of each working day. All scrap material and other waste shall be removed from the site by the contractor.
   c. Electrical contractor shall coordinate the electrical work with other trades, including but not limited to all construction documents, shop drawings, etc. for all structural and mechanical work. Electrical contractor shall secure shop drawings from other contractors and verify exact electrical characteristics of equipment to be wired. This is done before electrical contractor rough-in for subject equipment. If discrepancies are noted between the electrical contract drawings and the other contractor shop drawings, electrical contractor is to notify Engineer at once. Failure by the electrical contractor to perform this duty will not relieve him of the responsibility to correct wiring deficiencies at his expense.
   d. Drawings are diagrammatic, small scale and indicate the general arrangement of systems and work included. Electrical contractor shall apply for detailed information regarding the location of all equipment before rough-in as the final location may differ from that shown on drawings. Outlets, etc., improperly placed because of failure to obtain this information shall be relocated and reinstalled without additional expense. Certain raceways, bends, fittings, boxes, system components, appurtenances and related specialties are not shown, but shall be provided. Do not scale drawings.
   e. All electrical work required for identical items shown on the drawings shall be provided although each specific identical item may not be shown.
   f. Electrical contractor shall submit shop drawings and/or catalog cuts for all equipment, materials and devices for review by the Engineer. Work shall not start until all reviews have been completed and the items to be provided are acceptable. All materials and equipment shall be commonly used acceptable grades in the construction industry and shall bear the UL Label when applicable.
   g. All circuits shall be clearly identified at panelboards with typed circuit schedules. All other electrical equipment shall be labeled with white engraved with black lettering laminated nameplates.
   h. All wiring devices, panelboards, junction boxes, conduits, equipment, etc., shall be properly grounded.
   i. Upon completion of construction, the electrical contractor shall supply the Engineer with one (1) complete set of equipment manuals and as-built documents accurately showing the locations, sizes and nature of concealed items such as conduit, devices, equipment, etc., and homerun circuit designations as installed. These records (with dimensions where

necessary) form a permanent record for future reference.

j. All electrical work performed shall be as shown on the drawings and shall be accomplished to the satisfaction of the Engineer. Wire all fixtures, devices, etc., to respective panel and controls as shown on plans in symbol form. Branch circuit wiring is not completely shown on drawings. Contractor is responsible to wire all devices as circuited symbolically.

k. All branch circuits to contain a separate green insulated grounding conductor.

l. All conduit and/or cable shall be installed above suspended ceilings, and/or installed concealed in walls/floors in all finished areas.

m. Install panelboard accessory items according to NEMA PB 1.1.

n. Circuit Directory: Type directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing.

o. Any spared circuits to be disconnected, and wiring to be removed. Circuit breakers to remain and will be re-labeled accordingly.

p. Provide ground continuity to main electrical ground bus.

2. Field Quality Control: Perform acceptance tests as follows:

a. Make continuity tests of each circuit.

b. Procedures: perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

c. On completion of work, the wiring system shall be entirely free from grounds, short circuits, opens, overloads and improper voltages, and thorough tests shall be made. Furnish all labor, material and instruments.

3. Install all materials and equipment in a neat and workmanlike manner and provide for the following:

a. All work shall be installed so as to be readily accessible for operation, maintenance and repair. Minor deviations from the plans may be made to accomplish this, subject to the approval of the Engineer.

b. The area of work shall be kept free of litter and debris. Contractor shall clean up the work area at the end of each working day. All scrap material and other waste shall be removed from the site by the contractor.

c. Electrical contractor shall coordinate the electrical work with other trades, including but not limited to all construction documents, shop drawings, etc. for all structural and mechanical work. Electrical contractor shall secure shop drawing from other contractors and verify exact electrical characteristics of equipment to be wired. This is done before electrical contractor rough-in for subject equipment. If discrepancies are noted between the electrical contract drawings and the other contractor shop drawings, electrical contractor is to notify Engineer at once. Failure by the electrical contractor to perform this duty will not relieve him of the responsibility to correct wiring deficiencies at his expense.

d. Drawings are diagrammatic, small scale and indicate the general arrangement of systems and work included. Electrical Contractor shall apply for detailed information regarding the location of all equipment before rough-in as the final location may differ from that shown on drawings. Outlets, etc., improperly placed because of failure to obtain this information shall be relocated and

installed without additional expense. Certain raceways, bends, fittings, boxes, system components, appurtenances and related specialties are not shown, but shall be provided. Do not scale drawings.

e. All electrical work required for identical items shown on the drawings shall be provided although each specific identical item may not be shown.

f. All circuits shall be clearly identified at panelboards with printed circuit schedules. All other electrical equipment shall be labeled with white engraved with black lettering laminated nameplates.

B. GUARANTEE

1. Contractor for electrical work shall furnish a guarantee covering all labor, materials and equipment for a period of (1) one year from date of final acceptance of his work. He shall agree to repair and make good, at his own expense, any and all defects which may appear during this time of said guarantee.

3.2 COMMISSIONING

A. The ELECTRICAL Contractor shall assist the Commissioning Agent in the commissioning process. The Commissioning Agent will be a sub-contractor of the Owner. The Electrical Contractor's responsibilities shall include but not be limited to:

1. Providing a mechanic to operate the equipment, open panels, switch breakers, operation of lighting controls, providing lamp information, etc. as required by the Commissioning Agent during functional testing.

2. Verifying and checking off the preliminary "pre-functional" testing forms provided by the Commissioning Agent prior to the functional testing.

3.3 ELECTRICAL GENERAL REQUIREMENTS

A. SLEEVES AND ELECTRICAL PENETRATIONS

1. Location of Openings: Locate all chases, shafts and openings required for the installation of the electrical work during framing of the structure. Do any additional cutting and patching required due to improperly located or omitted openings without cost to the Owner, and with the approval of the Architect. Cutting or drilling in any structural member is prohibited without written approval of the Architect.

2. Location of Sleeves: Wherever conduits pass through concrete walls or suspended slabs, furnish and install sleeves of ample size to permit installation of conduit. Sleeves shall be installed prior to pouring of concrete and shall have ends flush with the wall or extend two (2") inches above floor surfaces. Verify location with the Architects.

3. Where sleeves pierce slabs or walls separating machine room areas from or other quiet areas, the sleeves shall be packed with fiberglass insulation to prevent noise transfer.

4. Where raceways for electrical power, telephone or signal cables penetrate FIRE RATED walls, floors, partitions or slabs, fill and seal all such penetrations with a one-part intumescent caulk/putty sealant creating a fire stop equal to or exceeding fire rating of partition being penetrated. Fire sealant

shall have ability to prevent spread of flame, smoke and water throughout the penetration and shall pass three (3) hour test, UL Test ASTM E814 and UL 1479. Fire sealant shall be 3M CP25 caulk and putty 303, installed in accordance with manufacturer's written instructions. Avoid all voids when arranging cables in penetration by using non-flammable fiber damming material wedged between cables.

5. Type of sleeves: Steel pipe or galvanized sheet metal is acceptable.
6. Finish Around Sleeves: Rough edges shall be finished smooth. Space between conduit and sleeves, where conduit passes through exterior walls and walls of existing structure, shall be sealed to permit movement of conduit, but prevent entrance of water.
7. Space between conduit and sleeves, where conduit passes through interior walls and slabs, shall be sealed with an approved sealing compound that is fireproof and will remain pliable.
8. Where faulty installation of sleeves, etc. occurs, the Electrical Contractor shall make all necessary changes and repairs, at no cost to the Owner, to the satisfaction of the Architect.
9. Where openings requested by the Electrical Contractor are left in floors or walls under other contracts, and are not used, such openings shall be filled in to match the adjoining work the Electrical Contractor.
10. All additional openings required and not requested while the work proceeds shall be cut as a part of the work of the appropriate trade and be paid for by the Electrical Contractor.

B. CUTTING AND PATCHING

1. The Electrical Contractor shall, at a time in advance of the work, verify all openings indicated on the drawings. Should the work of this Division require it, he shall furnish new instructions as to his requirements for these openings, subject to the Architect's approval. All additional cutting, patching and reinforcement of the construction of the building (subject to the Architect's approval) shall be performed under the section of the specifications covering the particular materials, but the cost shall be an obligation of this section of the work.
2. The Contractor shall provide and pay for the addition of all structural steel required for the support or bracing of all work furnished and installed.

C. CLEANING AND PAINTING

1. Conduit and Equipment to be Installed: Clean thoroughly to remove plaster, splattered paint, cement and dirt, on both exterior and interior.
2. Conduit and Equipment to be Painted: Clean all conduit exposed to view in completed structure by removing plaster and dirt. Remove grease, oil and similar material from conduit and equipment by wiping with clean rags and suitable solvents in preparation for paint.
3. All items with Factory Finish: Remove cement, plaster, grease and oil, and leave all surfaces, including cracks and corners, clean and polished. Touch up any scratched or bare spots to match finish. Factory finish may be approved as prime coat by the Architect. See Painting Section.

4. All electrical apparatus and equipment in equipment rooms shall be provided with a factory finish cost. All panels in public spaces, corridors, etc. shall be provided with a factory prime coat.
5. Site Cleaning: Remove from site all packing cartons, scrap materials, and other rubbish relating to electrical installation.

D. TESTS

1. Conduct resistance to ground tests by qualified personnel to measure resistance to ground at all grounding electrodes. Make tests before slabs of affected areas are poured, in order that corrective measures, if required, may be taken. Submit to the Architect a report showing the results of these measurements. If the resistances exceed values specified elsewhere, perform all corrective measures as directed by the Architect.
2. Upon completion of the work and adjustment of all equipment, conduct an operating test for approval at such time as the Architect directs. Conduct the test in the presence of an authorized representative of the Architect. Demonstrate all systems and equipment to operate, in accordance with all requirements of the contract documents, and to be free from all electrical and mechanical defects.
3. All systems shall be free from short circuits and grounds, and shall show an insulation between phase conductors and ground not less than the requirements of the National Electrical Code. Test all circuits for proper neutral connections.
4. Complete all tests prior to final inspection of the project.
5. Preliminary Operations: Should the Owner require that any portion of the systems or equipment be operated prior to the final schedule dates for completion and acceptance of the work, the contractor shall consent. Such operation shall be under the direct supervision of, and at the expense of the Contractor, and shall not be construed as an acceptance of any of the work by the Owner.

E. OPERATING, INSTRUCTIONS AND SUPERINTENDENT

1. The services of an experienced superintendent shall be provided, who shall constantly be in charge of the erection of the systems in this Division, and who shall have complete knowledge of the design, operation and maintenance of all machinery, apparatus and other work installed under his supervision.
2. Upon the completion of the work, and prior to the final completion date, the Contractor shall submit to the Architect a letter signed by the Owner's representative stating that the Owner has been instructed in the proper operation of all installed equipment.

3.4 BASIC ELECTRICAL MATERIAL & METHODS

A. APPLICATION

1. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
2. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

3. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
4. Right of Way: Give to raceways and piping systems installed at a required slope.

B. RACEWAY APPLICATION

1. Use the following raceways for outdoor installations:
   a. Exposed: IMC
   b. Concealed: IMC
   c. Underground, Single Run: RNC
   d. Underground, Grouped: RNC
   e. Connection to Vibrating Equipment: LFMC
   f. Boxes and Enclosures: NEMA 250, Type 3R.
   g. Use the following raceways for indoor installations:
      1. Exposed: EMT
      2. Concealed: EMT
      3. Connection to Vibrating Equipment: FMC; except in wet or damp locations, use LFMC
      4. Damp or Wet Locations: IMC
      5. Boxes and Enclosures: NEMA 250, Type 1, unless otherwise indicated.

C. RACEWAY AND CABLE INSTALLATION

1. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
2. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot water pipes. Locate horizontal raceway runs above water and steam piping.
3. Use temporary raceway caps to prevent foreign matter from entering.
4. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
5. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.
6. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch concrete cover.
   a. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
   b. Space raceways laterally to prevent voids in concrete.
   c. Install conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
   d. Transition from non-metallic tubing to Schedule 80 non-metallic conduit, rigid steel conduit, or IMC before rising above floor.
   e. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for exposed parallel raceways.

7. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12-inches of slack at each end of the pull wire.
8. Install telephone and signal system raceways, 2-inch trade size and smaller, in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.
9. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of 72-inch flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.
10. Set floor boxes level and trim after installation to fit flush to finished floor surface.

D. WIRING METHODS FOR POWER, LIGHTING, AND CONTROL CIRCUITS
1. Feeders: Type THHN/THWN insulated conductors in raceway as allowed by code.
2. Underground Feeders and Branch Circuits: Type THWN insulated conductors in raceway.
3. Branch Circuits: Type THW or THHN/THWN insulated conductors in raceway where exposed. Metal-clad cable where concealed in ceilings and gypsum board partitions.
4. Remote-Control Signaling and Power-Limited Circuits: Type THHN/THWN insulated conductors in raceway for Classes 1, 2 and 3, unless otherwise indicated.

E. WIRING INSTALLATION
1. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
2. Install wiring at outlets with at least 12 inches of slack conductor at each outlet.
3. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals, according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

F. ELECTRICAL SUPPORTING DEVICE APPLICATION
1. Damp Locations and Outdoors: Hot-dip galvanized materials or non-metallic, U-channel system components.
2. Dry Locations: Steel materials.
3. Support Clamps for PVC Raceways: Click-type clamp system.
4. Selection of Supports: Comply with manufacturer's written instructions.
5. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

G. SUPPORT INSTALLATION
1. Install support devices to securely and permanently fasten and support electrical components.

2. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
3. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
4. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
5. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
6. Install ¼-inch diameter or larger threaded steel hanger rods, unless otherwise indicated.
7. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
8. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
9. Simultaneously install vertical conductor supports with conductors.
10. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
11. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
12. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
13. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
    a. Wood: Fasten with wood screws or screw-type nails.
    b. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
    c. New Concrete: Concrete inserts with machine screws and bolts.
    d. Existing Concrete: Expansion bolts.
    e. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
    f. Steel: Welded threaded studs or spring-tension clamps on steel.
    g. Field Welding: Comply with AWS D1.1.
    h. Welding to steel structure may be used only for threaded studs, not for

conduits, pipe straps, or other items.

i. Light Steel: Sheet-metal screws.

j. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

H. IDENTIFICATION MATERIALS DEVICES

1. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
2. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
3. Self-Adhesive Identification Products: Clean surfaces before applying.
4. Identify raceways and cables with color banding as follows:
   a. Bands: Pre-tentioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
   b. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
   c. Colors: As follows:
      1. Fire Alarm System: Red.
      2. Security System: Blue and Yellow.
      3. Telecommunication System: Green and Yellow.
5. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
6. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.
7. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   d. Neutral: White.
   e. Ground: Green.
8. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

I. FIRESTOPPING

1. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

J. CUTTING AND PATCHING

1. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
2. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

K. FIELD QUALITY CONTROL

1. Inspect installed components for damage and faulty work, including the following:
   a. Raceways.
   b. Building wire and connectors.
   c. Supporting devices for electrical components.
   d. Electrical identification.
   e. Electricity-metering components.
   f. Concrete bases.
   g. Electrical demolition.
   h. Cutting and patching for electrical construction.
   i. Touchup painting.
2. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.
   a. Connect a load of known kW rating, 1.5 kW minimum, to a circuit supplied by the metered feeder.
   b. Turn off circuits supplied by the metered feeder and secure them in the "off" condition.
   c. Run the test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use a test load placement and setting that ensure continuous, safe operation.
   d. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at the test load connection. Record test results.
   e. Repair or replace malfunctioning metering equipment or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

L. REFINISHING AND TOUCHUP PAINTING

1. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."
   a. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
   b. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

c. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

d. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

M. CLEANING AND PROTECTION

1. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
2. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

3.5 GROUNDING & BONDING

A. APPLICATION

1. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
2. In raceways, use insulated equipment grounding conductors.
3. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections.
4. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
5. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
6. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   a. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
   b. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.
7. Underground Grounding Conductors: Use tinned-copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

B. EQUIPMENT GROUNDING CONDUCTORS

1. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
2. Install equipment grounding conductors in all feeders and circuits.
3. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
4. Non-metallic Raceways: Install an equipment grounding conductor in non-metallic raceways unless they are designated for telephone or data cables.
5. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

6. Water Heater Cables: Install a separate equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.
7. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   a. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a ¼-by-2-by-12-inch grounding bus.
   b. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
8. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

C. INSTALLATION

1. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact or damage.
2. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
3. Metal Water Service Pipe: Provide insulation copper grounding conductors, in conduit, from buildings' main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
4. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
5. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
6. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

D. CONNECTIONS

1. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   a. Use electroplated or hot tin coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
   b. Make connections with clean, bare metal at points of contact.
   c. Make aluminum-to-steel connections with stainless-steel separators and

mechanical clamps.

d. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.

e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

2. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

3. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

4. Non-contact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding and bushings and bare grounding conductors, unless otherwise indicated.

5. Connections at Test Wells: Use compression-Type connectors on conductors and make bolted-and clamped-type connections between conductors and ground rods.

6. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

7. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

8. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

E. FIELD QUALITY CONTROL

1. Testing: Perform the following field quality-control testing:

a. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

b. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.

c. Provide drawings locating each ground rod and ground rod assembly and other grounding observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to

improve test results.

d. Equipment Rated 500 kVA and Less: 10 ohms.

e. Substations and Pad-Mounted Switching Equipment: 5 ohms.

f. Manhole Grounds: 10 ohms.

g. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

F. GRADING AND PLANTING

1. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Re-establish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Maintain restored surfaces. Restore disturbed paving as indicated.

3.6 CONDUCTORS & CABLES

A. EXAMINATION

1. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation unsatisfactory conditions have been corrected.

B. WIRE AND INSULATION APPLICATIONS

1. Service Entrance: Type RHW or THWN, in raceway.
2. Feeders: Type THHN/THWN, in raceway.
3. Branch Circuits: Type THHN/THWN, in raceway.
4. Fire Alarm Circuits: Power-limited, fire-protective, signaling circuit cable.
5. Fire Alarm Circuits: Type THHN/THWN, in raceway.
6. Class 1 Control Circuits: Type THHN/THWN, in raceway.
7. Class 2 Control Circuits: Power-limited tray cable, in cable tray.
8. Class 2 Control Circuits: Power-limited cable, concealed in building finishes.
9. Class 2 Control Circuits: Type THHN/THWN, in raceway.

C. INSTALLATION

1. Install wires and cables as indicated, according to manufacturer’s written instructions and NECA’s “Standard of Installation.”
2. Remove existing wires from raceway before pulling in new wires and cables.
3. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer’s recommended maximum pulling tensions and sidewall pressure values. Provide pull boxes and splice boxes as required.
4. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
5. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

6. Support cables according to Division 16 Section “Basic Electrical Materials and Methods.”
7. Seal around cables penetrating fire-rated elements according to Division 7 Section 07840.
8. Identify wires and cables according to Division 16 Section “Basic Electrical Materials and Methods.”
9. Identify wires and cables according to Division 16 Section “Electrical Identification.”

D. CONNECTIONS

1. Conductor Splices: Keep to minimum.
2. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
3. Use splice and tap connectors compatible with conductor material.
4. Use oxide inhibitor in each splice and tap connector for aluminum conductors.
5. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.
6. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
7. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

E. FIELD QUALITY CONTROL

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
2. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.7 BRANCH CIRCUITRY

A. For all lighting and appliance branch circuitry, raceway sizes shall conform to industry standard maximum permissible occupancy requirements except where these are exceeded by other requirements specified elsewhere.

B. Circuits shall be balanced on phases at their supply as evenly as possible.

C. Feeder connections shall be in the phase rotation which establishes proper operation for all equipment supplied.

D. Reduced size conductors indicated for any feeders shall be taken as their grounding conductors.

E. Feeders consisting of multiple cables and raceways shall be arranged such that each raceway of the feeder contains one cable for each leg and one neutral cable, if any.

F. For circuitry indicated as being protected at 20 Amps or less, abide by the following:

1. All 20 amp, 120/208 volt, 3 phase, 3 wire combined branch circuit homeruns shall be provided with a #8 AWG neutral conductor.
2. Minimum conductor size shall be No. 12 A.W.G. copper.

3. Conductors operating at 115 volts extending in excess of 100 Ft. or the last outlet or fixture tap shall be No. 10 A.W.G. copper throughout.
4. Lighting fixtures and receptacles shall not be connected to the same circuit.
5. Circuits shall be balanced on phases at their supply point as evenly as possible.

3.8 IDENTIFICATION AND TAGGING

A. Identify individually:
1. Each transformer.
2. Each panel-board.
3. Each switch and circuit breaker.
4. Each feeder, wire or cable of all systems.
5. Each switchboard.
6. Each end of nylon pull-wire in empty conduit.

B. Each wire or cable in a feeder shall be identified at its terminal points of connection and in each pull-box, junction box and panel gutter through which it passes.

C. The nomenclature used to identify panel-boards or load center shall designate the numbers assigned to them.

D. The nomenclature used to identify switches or circuit breakers shall:
1. Where they disconnect mains or services designate this fact.
2. Where they control feeders, designate the feeder number and the name of the load supplied.
3. Where they control lighting and appliance branch circuitry, designate the name of the space and the load supplied.

E. The nomenclature used to identify feeder wires and cables shall designate the feeder number.

F. Identification for panel-boards or load centers shall be by means of engraved lama-coid nameplates showing 1/4" high white lettering on a black background fastened to the outside face of the front.

G. Identification for switches or circuit breakers shall be by means of the following:
1. Where individually enclosed -- engraved lama-coid nameplates showing 1/8" high white lettering on a black background fastened on the outside front face of the enclosure.
2. Where in panel-boards or load centers without doors -- same as for individually enclosed.
3. Where in panel-boards or load centers with doors -- typewritten directories mounted behind transparent plastic covers, in metal frames fastened on the inside face of the doors.

H. Identification for wires and cables shall be by means of wrap around "brady" type labels.

I. Device plates for local toggle switches, toggle switch type motor starters, pilot lights and the like, whose function is not readily apparent shall be engraved with 1/8" high letters suitably describing the equipment controlled or indicated.

J. These identification letters shall be stamped into the metal of the bus bars of each phase of the main busses of each switchboard and each panel-board. The letters

shall be visible from at least one "normal posture" location without having to demount any current carrying or supporting elements.

K. Equip the front face of all switchboard pull boxes junction boxes and the like containing cables, busing or devices operating in excess of 600 volts with enameled sheet metal "red on white" signs reading "DANGER--HIGH VOLTAGE."

L. Identify each outlet box, junction box, and cabinet used in conjunction with empty raceway for wires of a future system by means of indelible markings on the inside denoting the system.

M. Prior to installing identifying tags and nameplates, submit their nomenclature for approval. Conform to all revisions issued by the Architect.

3.9 RACEWAYS AND BOXES

A. EXAMINATION

1. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. WIRING METHODS

1. Outdoors: Use the following wiring methods:
   a. Exposed: Rigid steel.
   b. Concealed: Rigid steel or IMC.
   c. Underground, Single Run: RNC.
   d. Underground, Grouped: RNC.
   e. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   f. Boxes and Enclosures: NEMA 250, Type 3R.
   g. Others as approved elsewhere in this specification.
2. Indoors: Use the following wiring methods:
   a. Exposed: EMT.
   b. Concealed: EMT.
   c. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
   d. Damp or Wet Locations: Rigid steel conduit.
   e. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
   f. Damp or Wet Locations: NEMA 250, Type 4, stainless steel or nonmetallic as shown on drawings.
   g. Others as approved elsewhere in this specification.

C. INSTALLATION

1. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
2. Minimum Raceway Size: 3/4-inch trade size.

3. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
4. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
5. Install raceways level and square and at proper elevations. Provide adequate headroom.
6. Complete raceway installation before starting conductor installation.
7. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."
8. Use temporary closures to prevent foreign matter from entering raceways.
9. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
10. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
11. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
12. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
13. Raceways Embedded in Slabs: Install in middle third of slab thickness where practical, and leave at least 1-inch concrete cover.
    a. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
    b. Space raceways laterally to prevent voids in concrete.
    c. Run conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
    d. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
14. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
    a. Run parallel or banked raceways together, on common supports where practical.
    b. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
15. Join raceways with fittings designed and approved for the purpose and make joints tight.
    a. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
    b. Use insulating bushings to protect conductors.
16. Tighten set screws of threadless fittings with suitable tools.
17. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against

the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.

18. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
19. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200lb tensile strength. Leave at leaswt 12 inches of slack at each end of the pull wire.
20. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to the above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
21. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
    a. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.
    b. Where otherwise required by NFPA 70.
22. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
23. Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semi recessed lighting fixtures; for equipment subject to vibration, noise transmission,movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
24. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
25. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.
    a. Select each surface raceway outlet box, to which a lighting fixture is attached, of sufficient diameter to provide a seat for the fixture canopy.
    b. Where a surface raceway is used to supply a fluorescent lighting fixture having central stem suspension with a backplate and a canopy (with or without extension ring), no separate outlet box is required.
    c. Provide surface metal raceway outlet box, and the backplate and canopy, at the feed in location of each fluorescent lighting fixture having end-stem suspension.

d. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed, no additional surface-mounted outlet box is required. Provide a backplate slightly smaller than the fixture canopy.

26. Set floor boxes level and adjust to finished floor surface.
27. Set floor boxes level and trim after installation to fit flush to finished floor surface.
28. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

D. PROTECTION

1. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
   a. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   b. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

E. CLEANING

1. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.10 WIRING DEVICES

A. INSTALLATION

1. Install devices and assemblies plumb and secure.
2. Install wall plates when painting is complete.
3. Install wall dimmers to achieve indicated rating after de-rating for ganging as instructed by manufacturer.
4. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
5. Protect devices and assemblies during painting.
6. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

B. IDENTIFICATION

1. Comply with Division 16 Section "Basic Electrical Materials and Methods."

C. CONNECTIONS

1. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
2. Tighten electrical connectors and terminals according to manufacturers published torque tightening values. If manufacturers torque values are not indicated, use those specified in UL 486AandUL486B.

D. FIELD QUALITY CONTROL

1. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.

2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
3. Replace damaged or defective components.

E. CLEANING

1. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

3.11 FUSED POWER CIRCUIT DEVICES

A. INSTALLATION

1. Mount individual wall mounting switches with tops at uniform height, unless otherwise indicated. Anchor floor mounting switches to floor or equipment base.
2. Provide one set of spare fuses.

B. FIELD QUALITY CONTROL

1. Inspect interior of switch enclosures for the following:
   a. Mechanical and electrical connections
   b. Switch and relay type and labeling verification
   c. Rating of installed fuses.
   d. Proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer’s certification.

3.12 PANELBOARDS

A. INSTALLATION

1. Install panelboards and accessories according to NEMA PB 1.1.
2. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
3. Circuit Directory: Create directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
4. Install filler plates in unused spaces.
5. Provision for Future Circuits at Flush Panelboards: Stub four 1 inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1 inch empty conduits into raised floor space or below slab not on grade.
6. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

B. IDENTIFICATION

1. Identify field installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section “Basic Electrical Materials and Methods.”
2. Panelboard Nameplates: Label each panelboard with engraved metal or laminated plastic nameplate mounted with corrosion resistant screws.

C. CONNECTIONS

1. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.

2. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. FIELD QUALITY CONTROL

1. Prepare for acceptance tests as follows:
   a. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   b. Test continuity of each circuit.
2. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
   a. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded case circuit breakers. Certify compliance with test parameters.
   b. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, otherwise, replace with new units and retest.
   a. Measure as directed during period of normal system loading.
   b. Perform load balancing circuit changes outside normal occupancy/working schedules of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
   c. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
   d. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

E. ADJUSTING

1. Set field-adjustable switches and circuit breaker trip ranges.

F. CLEANING

1. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris, do not use compressed air to assist in cleaning.

3.13 FUSES

A. EXAMINATION

1. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.
2. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. FUSE APPLICATION

1. Main Service: Class L, fast acting.
2. Main Feeders: Class J, time delay.
3. Motor Branch Circuits: Class RK1, time delay.
4. Other Branch Circuits: Class RK.5, non-time delay.

C. INSTALLATION

1. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.

D. IDENTIFICATION

1. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

3.14 DISCONNECT SWITCHES AND CIRCUIT BREAKERS

A. INSTALLATION

1. Install disconnect switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.
2. Install disconnect switches and circuit breakers level and plumb.
3. Install wiring between disconnect switches, circuit breakers, control, and indication devices.
4. Connect disconnect switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer.
5. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
6. Identify each disconnect switch and circuit breaker according to requirements specified in Division 16 Section "Basic Electrical Materials and Methods."

B. FIELD QUALITY CONTROL

1. Testing: After installing disconnect switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.
3. Perform visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for disconnect switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

C. ADJUSTING

1. Set field adjustable disconnect switches and circuit breaker trip ranges as indicated.

D. CLEANING

1. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

3.15 INTERIOR LIGHTING

A. INSTALLATION

1. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.
2. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
   a. Install a minimum of four ceiling support system rods or wires for each

fixture. Locate not more than 6 inches from fixture corners.

b. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.

c. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

3. Suspended Fixture Support: As follows:

a. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

b. Stem Mounted, Single Unit Fixtures: Suspend with twin stem hangers.

c. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

d. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on Drawings.

B. CONNECTIONS

1. Ground equipment.

a. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

C. FIELD QUALITY CONTROL

1. Inspect each installed fixture for damage. Replace damaged fixtures and components.

2. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

3. Corrosive Fixtures: Replace during warranty period.

D. CLEANING AND ADJUSTING

1. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

2. Adjust aimable fixtures to provide required light intensities.

3.16 TESTS

A. Furnish all labor, material, instruments, supplies and services and bear all costs for the accomplishment of tests herein specified. Correct all defects appearing under test, repeat the tests until no defects are disclosed. Leave the equipment clean and ready for use.

B. The Electrical Contractor shall perform any test other than herein specified which may be specified by legal authorities or by agencies to whose requirements this work is to conform.

3.17 FINAL INSPECTION AND TEST

A. Prior to test, feeders and branches shall be continuous from service contact point to each outlet include: all panels, feeders and devices. Test system free from short circuits and grounds with insulation resistances not less than outlines in the National Electrical Code. Provide testing equipment necessary and conduct test in presence of the Owner's representative.

B. The final inspection and test shall include the following:
   1. Testing of the emergency lighting system.
   2. Testing of the impedance of the grounding system.
   3. Testing of each outlet.
   4. Testing of branch and feeder conductors for continuity.
   5. Testing of panel boards to verify proper current balance and voltage.
   6. Testing of motors, verifying proper phase rotation, current balance and voltage.
   7. Testing, targeting and focusing of all adjustable lighting fixtures.

3.18 ELECTRIC WIRING OF MOTORS AND EQUIPMENT

A. Power wiring and disconnect switches for the proper isolation of each piece of equipment shall be provided under the electrical sections of the specifications, as necessary for operation in the "HAND" position of the HAND-OFF-AUTO control switch.

B. The electrical design is based on the equipment listed in the schedules. Parties furnishing equipment-requiring changes in the electrical design shall pay costs involved in modifying the electrical design to accommodate the equipment involved.

C. Control and interlock wiring for the mechanical systems shall be provided under the mechanical sections of the specifications, as necessary for operation in the "AUTO" position of the HAND-OFF-AUTO control switch. Wiring shall be in strict accordance with wiring diagrams, previously submitted and reviewed "acceptable." Systems include:
   1. Plumbing.
   2. Fire Protection.
   3. Heating, Ventilating, Cooling.
   4. Temperature Controls.

D. Furnish complete integrated systems wiring diagrams showing the detailed power wiring, the interlock wiring, and the controls wiring, each relating to the exact equipment purchased for the installation. Include diagram wiring for smoke (or products of combustion) and heat detection devices and equipment furnished in connection with air distribution systems and as well as diagram wiring as required to cause fans to stop if vibration switches are activated by excessive vibration.

E. Wiring diagrams shall be submitted within not more than thirty-five (35) days after equipment selections have been accepted. The diagrams shall be complete integrated wiring diagrams, not manufacturer's equipment drawings.

F. At the completion of the project, and before final inspection, those parties having detailed responsibility for (1) temperature control and interlock wiring diagrams; (2) equipment controlled by the temperature control system; and (3) installation of the temperature control and interlock wiring shall meet at the job site and jointly checkout, test and inspect each control circuit, each interlock and each power circuit to each piece of equipment, and shall advise in writing that each piece of equipment meets their joint approval insofar as performance, operation and interconnect are concerned. This "EQUIPMENT COMMISIONING' form shall be jointly signed by each responsible individual and included in record documents.

3.19 EQUIPMENT SPACE

A. The Drawings indicate scheduled products physically arranged in the spaces, based on catalog data of specific manufacturers.

B. Prepare Shop Drawings indicating the exact physical space requirements for equipment and servicing of equipment actually purchased for each item of equipment involved, and electrical connections, and be fully responsible for costs or modifications required for the installation.

3.20 SUPPORTS, SEISMIC DESIGN

A. Provide anchors, connections, bracing or other supports necessary to prevent damage to electrical systems or equipment, or to the building structure from such, as a result of an earthquake producing design horizontal seismic forces. Obtain building seismic rating from architect/ structural engineer.

3.21 INTERFERENCES

A. Relocate or reroute wiring, as required to facilitate construction of finished work as planned. Restore surfaces, insulation, and finish to match condition of adjacent work.

3.22 CUTTING AND PATCHING

A. Assume costs and responsibility for cutting and patching required to complete the installation.

B. Patch surfaces to the condition of the adjacent surfaces.

3.23 PAINTING AND FINISHING AND CLEANING

A. Finish painting (other than factory applied) and electrical equipment, and its associated conduit and devices are specified elsewhere in the Specifications. Provide touch-up painting of pre-finished electrical products.

B. Leave surfaces clean and remove debris.

3.24 OPTION TO RELOCATE OUTLETS AND RELATED DEVICES

A. Lighting fixtures, convenience outlets, floor outlets, telephone outlets may, at the Owners option, be relocated to a point within 10 feet of the location indicated on the Drawings, at no additional cost to the Owner, provided the Contractor is advised of this relocation before Shop Drawing preparation or roughing-in begins.

B. Only work, which must be re-performed in this connection, will be considered extra.

3.25 EQUIPMENT CONNECTIONS

A. Provide wiring for the connection of motors and control equipment and control wiring as indicated on the Electrical Drawings.

1. Equipment installed under other sections of the Specifications - wiring shall be extended to the equipment, and proper connections made thereto.

2. Flexible connections of short lengths - Shall be provided for equipment subject to vibration or movement and for motors. Liquid-tight conduit shall be used in wet locations. A separate ground conductor shall be provided across flexible connections.

a. Length of flexible connections for motors shall be at least 11-inches plus 1/4-inch per horsepower up to 100 hp, and need not be longer than 36-inches unless otherwise indicated.

b. Length of flexible connections for transformers shall be at least 11 -inches plus 1/4-inch per kVA up to 100 kVA, and need not be longer than 36-inches unless otherwise indicated.

3. Power connections to any vibration isolated equipment shall be made with a length of flexible conduit having a 90 degree bend in it between the junction box on the equipment and any non-flexible conduit.

4. Owner furnished equipment: Wiring shall be extended to the equipment, and proper connections made thereto.

3.26 OUTLET BOXES

A. Wall switches shall be mounted on the strike side of the doors, as finally hung, whether so shown on the Drawings or not.

B. More than one conduit connection to outlet or junction boxes smaller than 4 x 4 x 11/2-inches is prohibited.

C. Outlet boxes shall be placed at heights as scheduled and to meet ADA requirements. Otherwise, install at the following heights, center of box to finished floor level:

1. Wall switches - 4'-O".

2. Convenience outlets and telephones - l'-6".

3. Wall bracket outlets - 6'-6".

3.27 CONDUIT INSTALLATION

A. Coordinate installation of raceways with building structure and other mechanical trades, complete with bends, fittings, and junction and pull boxes to meet codes and make complete operating systems. Raceways 1-inch and larger shall not be run in concrete slabs without approval of structural engineer.

B. Complete continuous raceway shall be provided for pulling and installation of wires. All wiring shall be run in raceways unless otherwise specified.

C. In general, conduits shall be concealed in finished areas, and may be exposed in unfinished areas, run square to the building construction, and continuous from outlet to outlet, connected mechanically and electrically to assure grounding. Conduits shall be cut square, reamed to full size, shouldered without butting into couplings or fittings. The threads shall be of standard length and diameter required for the size of the conduit used, and graphite bearing thread lubricant shall be used in making up the threads. Running threads will not be acceptable. Conduits shall have a smooth interior surface free of obstructions, shall be capped with conduit seals during the construction period, shall be uniformly sloped to eliminate trapped condensation, shall be thoroughly cleaned and dry before pulling any wire. Conduit installation shall clear hot pipes not less than 6-inches.

D. Rigid conduit or electrical metallic tubing shall not be rigidly connected to vibrating equipment. Use flexible conduit or Sealtite.

E. Conduit installation above accessible ceilings shall be such that there will be no interference with the installation of lighting fixtures, air outlets or other devices.

F. Conduit installed underground, in concrete or masonry:

1. Joints shall be made liquid-tight and shall engage not less than five threads.

2. Conduit in concrete shall be placed so that no portion of the conduit or couplings are exposed, and at a sufficient depth to prevent cracking or spalling. Conduit 1-inch or larger shall not be placed in walls or slabs except as specifically indicated.
3. Provide red colored concrete encasement for scheduled conduit systems installed underground.
4. Steel conduit underground, which is not concrete encased, shall be given cold applied protective tape coating, applied in accordance with manufacturer's instructions.
5. Conduits embedded in slabs except as specifically indicated or written approval is obtained shall not cross structural expansion joints. Provide conduit expansion joints in the event such crossings are permitted.
6. Place all conduit concealed in poured-in-place structure behind reinforcement bars.

G. Exposed conduit shall be parallel with or at right angles to, building lines, beams or ceilings with symmetrical ends or metal boxes placed at changes in direction or at taps.

H. Connections to wiring enclosures - Secure conduits to outlet boxes or wiring enclosures with double lock nuts. Where conduit boxes with threaded hubs are used, conduits shall engage at least five threads in the hubs. Provide plastic insulating bushings for rigid conduits (similar to O.Z. Type A). Provide connectors with plastic insulated throats for electrical metallic tubing termination.

I. Provide cable supports at the top of vertical runs for conductors 4 AWG and larger, and otherwise where required by NEC.

J. Minimum size conduit is 1/2-inch.

3.28 FASTENINGS

A. Fastenings for raceways and boxes shall be made by means of toggle or expansion bolts sized for the loads imposed based on manufacturer's recommendations.

B. Fastenings to masonry or concrete shall be made by means of machine screws sized for the loads imposed based on manufacturer's recommendations.

C. Outlet box supported fixtures - Lighting outlets rigidly supported independently by means of expandable bar hangers or metal strut framing system affording a safe and substantial support for the equipment, and utilizing manufacturer's recommendations for the loads and conditions imposed. Fixtures will not be supported solely from the box cover bolts.

D. Outlet, pull, or junction boxes shall be supported from joists or other structural framing (not finish wall or ceiling panels) by expandable bar hangers or metal strut framing system.

E. Panels may be attached directly only to permanent structural walls. Support panels located on nonpermanent partition walls independent of the wall with metal strut framing system attached to permanent structure (slab or framing members).

3.29 RACEWAY SYSTEMS

A. Provide grounded raceway systems with conduit, cabinets, outlet boxes, junction boxes, backboards, and miscellaneous appurtenances required for complete system. Leave empty raceway systems complete with poly 200 lb nylon pull cord or #10 gage pull wire, minimum 2 feet extra length at each end, properly tagged to indicate terminal points and length of runs (at junction boxes as well as terminations).

B. Systems shall meet requirements of, be accepted by, and be approved by the code authority, utility, equipment supplier, Owner, Contractor or subcontractor furnishing system equipment and wiring for the system involved.

C. Provide minimum 3/4-inch size empty conduit unless otherwise indicated.

D. Partial raceway systems include systems that allow open wiring installed above accessible ceilings utilized as plenums (with special plenum cables) or where the ceiling cavity is not utilized as an air plenum. Hollow walls with system wall outlets may serve as raceway where approved by code. Provide wall plaster frames, coverlets, and pull wire from box to above accessible ceilings.

E. Furnish and install empty conduit, cabinets, outlet boxes junction boxes, backboards and other miscellaneous appurtenances required for the systems specified. Conduit shall be as specified, and empty systems left complete, with 14-gage steel pull wire in each unit, ends properly tagged. Backboard shall be as specified, and cabinets shall be complete with doors and snap latches as specified for "distribution Panel boards".

F. Underground conduit intended for future use shall be identified by permanent concrete markers indicating location and intended use. Locate at each end and at each change of direction as a minimum.

3.30 CONDUCTOR INSTALLATION

A. Wire and cable No. 10 and smaller shall be factory color-coded. Provide factory color-coding for No. 8 and No. 6 wire and cable or mark conductors on each end and in all junctions or pull boxes with three-inch band of colored pressure sensitive plastic tape or by the use of brilliant waterproof lacquer properly applied. Colors for each phase and the neutral shall be consistent throughout the system.

B. Color coding shall be:

C.

120/208 Volt	Phase
Black	A
Red	B
Blue	C
White	N
Green	G

D. When voltage to ground does not exceed 120 volts, the minimum size conductor for use in lighting and power branch circuits shall be No. 12 AWG, except that the minimum size for control circuits (switch legs) shall be No. 14 AWG. Home runs longer than 100 feet actual wire length from panel shall be no smaller than No. 10 AWG.

E. Cable terminals, taps and splices No. 6 and larger shall be made secure with UL listed solder less indenter compression barrel type connectors wherever practicable. UL listed setscrew lugs may be used on circuit breakers, motor starters, and switches not available with indenter connections. Joints in conductors No. 8 and smaller shall be made by applying a UL listed insulated, cadmium plated, live steel spring type connector in sizes up to the catalog capacity of the connector.

F. If permanently installed, do not install wires in conduit until entire system of conduit and outlet boxes is in place. Conductors shall be pulled using a UL listed wire lubricant.

G. Conductors in conduits shall be continuous and without splices except in junction boxes. Indenter compression barrel type lugs shall be used for stranded conductor terminations except UL listed bolted compression type connectors or lugs, factory furnished on such

devices as circuit breakers, switch units and motor starters, may be utilized. Indenter compression type connections shall be used to make splices, taps and motor connections.

H. Insulate splices, taps, and connections such that the insulation of the joint is no less than the insulation of the wire. Insulate with manufactured lock-on splice caps or build up with rubber tape applied directly to the joint, and then cover with thermoplastic electrical tape.

I. Exercise care when installing wire in conduit so as to prevent injury to the conductor insulation. Mechanical means of pulling shall not be used unless approved. Conductors shall be pulled using UL listed lubricant.

J. Whenever wiring leaves the conduit and terminates at a terminal board, the wiring shall be formed and laced with waxed twine, or plastic wire ties.

K. In the event circuits feed through outlet boxes, provide splice and pigtail for device connection, with sufficient slack to pull splice out of box at least 6-inches (for inspection).

L. Switched duplex receptacles: The ungrounded pole of each receptacle shall be provided with a separate terminal. Bottom receptacle shall be switched when installed.

3.31 ELECTRICAL TESTING

A. This Section applies to the testing of systems in Division 16 of the Specifications.

B. Qualifications:

1. Competent and experienced personnel, having done similar work in the past, and whose qualifications shall be subject to approval, shall perform testing of systems.

2. Submit names and qualifications of all persons proposed for testing of electrical systems and equipment.

C. Reports:

1. Provide reports and certificates required in each category of testing, adjusting and balancing, signed by both the technician performing the work and the Contractor as representing accurate, factual data, based on readings in the field.

2. Reports shall be in triplicate on 8-1/2 x 11 -inch white bond paper. Submit format for recording data for approval prior to use.

D. Equipment and Material:

1. Provide all meters, instruments, equipment and materials necessary for performance of tests.

2. Testing apparatus, not part of the permanent installation, shall remain the property of the Contractor.

3. Provide gaskets, lubricants and other expendable materials required to be replaced during the execution of the work.

4. Provide fuel, if any, as required for tests.

E. Equipment:

1. Test and adjusted all electrical equipment to insure correct functional performance. Inspect, lubricate, test and adjust equipment and correct defects or damages before connecting the equipment to the system.

F. Wiring:

1. Test power, lighting and control wiring or bus duct for continuity, short circuits and improper grounding.
2. Test each grounding circuit separately for continuity.
3. Values of insulation resistance shall meet the standards established by the National Electrical Code.
4. If faults are detected, the point or points of such fault shall be located and the defective wiring replaced at the Contractor's expense.

G. Acceptance Tests:

1. Leave the entire electrical system installed under this Contract in proper working order. Upon completion of the installation, an acceptance test shall be run to ascertain that starters, circuit breakers, motors, relays, indicating lights, pushbuttons, alarm devices and other electrical equipment and controls are operating correctly as required for the overall operation of the facility.

H. Submit certified reports indicating full compliance with test requirements.

I. Make replacements or repairs to tested products, which are damaged as result of tests.

J. Schedule tests at a time convenient to required witnesses or persons affected by the tests.

K. Give written notification for test procedures, prior to the test.

L. Upon completion of the work, recheck electrical connections, cable to bus, cable to panels, bus to bus, throughout the job for tightness.

M. Check motors for correct rotation.

N. Test electrical systems grounding prior to completion of the work. Note ground resistance together with method of testing. For ground rods, note the soil condition at the time measurements were made. Ground resistance shall not exceed 25 ohms.

O. Test feeder and power circuits No. 8 AWG or larger with a "Megger" from each conductor to ground and between conductors. Record each reading. At the completion of work certify the results of the "Megger" testing.

P. After the electrical equipment and the wiring is installed, and prior to energizing for the first time any section of the electrical system, test phase-to-phase and phase-to-ground insulation on feeders and sub-feeders switchboards, dry-type transformers, motors, and other pieces of electrical equipment to assure that they have the proper insulation and are free of grounds. Systems rated above 250 volts shall be tested with a 1000-volt Megger. Circuits rated at or below 250 volts shall be tested with a 500-volt Megger.

Q. Energize each receptacle outlet and test each outlet with a plug-in receptacle circuit tester with indication for "correct wiring", "open ground', "hot ground", "reversed polarity", "open neutral', "hot unwired", "hot and ground reversed", "GFCI trip', and "GFCI test'. Correct any deficiencies discovered during testing.

R. Light and test each lamp. Prove and test energy available at the load side of disconnects switches, breakers and the final point of connection to driven equipment. Make such reasonable tests required to assure a complete electrical installation in first class condition and ready for operation.

S. Branch circuits served from lighting panel boards vary in loading. When entire load is turned on and system is operating at 100 percent demand, the initial unbalance should not

exceed 10 percent. In the event greater unbalance exists, report the measured individual branch circuit loads and panel feeder loads and request instructions.

T. Furnish at the completion of the Project a final inspection certificate from the local inspecting authority.

U. Perform the following testing and certify test results-

1. Phase-to-phase and phase-to-ground resistance
    a. At the supply line terminals of each item of electrical distribution system equipment.
    b. At supply side of each feeder and sub-feeder.
    c. At high voltage and at low terminals of each transformer.
    d. At line terminals of each motor.
    e. At any other point required by the Architect.
2. Ground resistance at each panel neutral bus.
3. Voltage to ground on each secondary leg of each transformer at no load and full load.
4. Service voltage at switchboard at full load between phases and to ground.
5. Line current in each line of each power transformer and at switchboard at full load, taken at completion of project.

V. Failures or improper operations shall be corrected. Furnish necessary test equipment and pay cost of testing, replacing and repairing.

3.32 TELECOMMUNICATIONS

A. CLEANING UP AND WARRANTY

1. The Contractor shall remove all oil, grease, or other stains resulting from his work performed in the building or the exterior thereof.

2. The Electrical Systems and associated materials shall be covered by the warranty for a period of one year. All materials, installation, and workmanship shall be warranted during the warranty period. That is, any item will be repaired at no charge for any defects for one year after the date of acceptance.

END OF SECTION

SECTION 270000 – GENERAL COMMUNICATIONS REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. The scope of work specified by these documents shall result in the provision, installation and testing of the following Telecommunications Communications infrastructure, systems and equipment.

B. Sustainable Design Intent

Comply with project requirements intended to achieve sustainable design, measured and documented according to LEED Green Building Rating System of the US Green Building Council. Refer to section 0108113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

1. All Voice and Data Wiring
   a. Contractor to provide all new CAT 6 cabling at all telecom outlet locations. Refer to drawings for outlet locations.
      1) All new CAT 6 cables shall be terminated onto existing patch panels, if existing space is not available, contractor to provide new CAT 6 patch panels and labeled.
      2) Mount new patch panels within the existing wall mount rack
2. Audio / Video Displays (wiring only)
   a. Contractor to provide all new CAT 6 cabling at all telecom outlet locations. Refer to drawings for outlet locations.
3. Gateway for Wireless Locks(wiring only).
   a. All Gateways locations are to receive new CAT6 cabling.
4. Patch Cords
      1) Provide (1) 7’ CAT 6 patch cord for each device end, and (1) 3’ cord for the patch panel end.
      2) Provide (2) patch cords for each new terminated patch panel port.

C. Systems shall utilize digital technology to integrate the following systems into a single network linking them to a central site:

1. LAN/Wi-Fi Systems

   a. Locally, the facility will be provided with a Local Area Network for all local data and video connectivity.

   b. Gateways shall be provided by the Security Contractor. Telecom Contractor to provide a minimum of 20’ of cable slack at the device end.

D. Telephone system (VoIP)

1. The telephone system shall be furnished, installed and programmed by the owner.

E. These systems shall be integrated by means of an in building Network of cables.

1. Cable Infrastructure
   a. All technology cabling for the new facility will be integrated with the data network and telephone system, utilizing Category 6 for all cabling.

2. Based on distance limitations from MDF to the devices, the cabling distance standard of 290' for data networks shall be adhered to. If any cabling is over 295 feet Game Changer 22AWG 4 pair cable shall be installed
3. All wiring will be in stub-ups or free air to J-hooks.

NOTE:The Telecommunications Contractor shall ensure that the General Contractor and Painting Contractor acknowledge that painting of or over spray any single or group of 4 pair horizontal telecommunications Category 6 cable is not allowed. Any painted or over sprayed cable(s) shall be replaced at the telecommunications and/or painting contractor's expense. Painted Cable will not be covered as part of an extended warranty. Painted cable in addition to obscuring the print legend may act as an accelerant or create an additional smoke hazard in the event of a fire and as such this is considered a life safety issue.

1.2 SUMMARY OF WORK

A. Associated "T" drawing series attached

1.3 REGULATIONS AND CODE COMPLIANCE

A. All work and materials shall conform to and be installed, inspected and tested in accordance with the most current governing rules and regulations of federal, state and local governmental agencies.

B. The following is a list of codes and standards that will apply to this project:

1. Federal Occupational Safety and Health Administration - OSHA.
2. National Life Safety Code, NFPA 101.
3. National Electrical Code (NEC), NFPA 70
4. Underwriters Laboratory (UL).
5. Factory Mutual and/or Owner's Insurance Carrier.
6. ANSI/TIA - Telecommunications Building Wiring Standards (Most current addition, revision and addenda), including, but limited to, the following compilation series of documents: 568, 570, 598, 606, 607, 758, , FIP 174, FIP175, FIP176,
7. BICSI Telecommunications Distribution Methods Manual, Telecommunications Cabling Installation Manual, Customer-Owned Outside Plant Manual, LAN and Internetworking Design Manual.
8. IEEE Standards.
9. IEEE-SA - National Electrical Safety Code (NESC)
10. Federal Communications Commission.
11. NEMA – National Electrical Manufacturers' Association

12. CSA – Canadian Standards Association
13. Owner's Environmental Health and Safety Standards.
14. Owner's Construction Standards.
15. ADA, Americans with Disabilities Act.

1.4 GLOSSARY

A. ANSI: American National Standards Institute

B. ASME: American Society of Mechanical Engineers

C. ASTM: American Society for Testing Materials

D. BICSI: Building Industry Consulting Services International

E. CSA: Canadian Standards Association

F. FCC: Federal Communications Commission

G. FM: Factory Mutual Insurance Company

H. IEEE: Institute of Electrical and Electronics Engineers

I. IRI: Industrial Rick Insurers

J. ISO: International Standards Organization

K. NEC: National Electrical Code (latest applicable edition

L. NEMA: National Electrical Manufacturers' Association

M. NESC: National Electrical Safety ode

N. NFPA: National Fire Protection Association

O. OSHA: Occupational Safety and Health Administration

P. TIA: Telecommunications Industry Association

Q. UFPO: Underground Facilities Protective Organization

R. UL: Underwriter's Laboratories, Inc.

1.5 DEFINITIONS

A. Approved / Approval: Written permission to use a material or system.

B. As Called for: Materials, equipment including the execution specified/shown in the contract documents.

C. Code Requirements: Minimum requirements

D. Concealed: Work installed in pipe and duct shafts, chases or recesses, inside walls, above ceilings, in slabs or below grade.

E. Design Equipment: Refer to the article, BASIS OF DESIGN.

F. Design Make: Refer to the Article, BASIS OF DESIGN.

G. Equal or Equivalent: Equally acceptable as determined by Owner's Representative.

H. Exposed: Work not identified as concealed.

I. Final Acceptance: Owner acceptance of the project from Contractor upon certified by Owner's Representative.

J. Furnish: Supply and deliver to installation location.

K. Furnished by Others: Receive delivery at job site or where called for and installed.

L. Inspection: Visual observations by Owner's site Representative.

M. Install: Mount and connect equipment and associated materials ready or use.

N. Labeled: Refers to classification by a standards agency.

O. Make: Refer to the article, BASIS OF DESIGN.

P. Or Approved Equal: Approved equal or equivalent as determined by Owner's Representative.

Q. Owner's Representative: Mast Construction

R. Prime Professional: Architect or Engineer having a contract directly with the Owner for professional services.

S. Provide: Furnish, install and connect ready for use.

T. Relocate: Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready for use.

U. Replace: Remove and provide new item.

V. Review: A general contractual conformance check of specified products. W. Roughing: Pipe, duct, conduit, cabling, equipment layout and installation.

W. Satisfactory: As specified in contract documents.

X. Site Representative: Construction Manager or Owner's Inspector at the work site.

Y. Refer to General Conditions of the Contract for additional definitions.

1.7 INTENT OF DRAWINGS

A. The drawings are diagrammatic, unless detailed dimensioned drawings are included. Drawings show approximate locations of equipment, and fixtures. Exact locations are subject to the approval of the Owner's Representative.

B. The Contractor should verify all dimensions locating the work and its relation to existing work, all existing conditions and their relation to the work and all man-made obstructions and conditions, etc. affecting the completion and proper execution of the work as indicated in the Contract Documents.

C. Related Documents

1. Drawings, General Conditions, and Special Conditions related to this project are found in this Division, as well as the other Divisions included in the Contract Documents.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS MINIMUM REQUIREMENTS:

A. Materials requirements:

1. All equipment and material for which there is a listing service shall bear a UL label.
2. Electrical equipment and systems shall meet UL Standards and requirements of the NEC and CSA. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
3. Equipment shall meet all applicable FCC Regulations
4. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material will be rejected.
5. The listing of a manufacturer as “acceptable” does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications and meet the quality of the design make.
6. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory of Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

2.2 CABLES

A. Any cable associated with this Contract, passing through two or more floors shall be suitable, listed by a Nationally Recognized Testing Laboratory (NRTL) and marked for use in a riser or plenum application. Riser cable shall minimally be CMR or OFNR rated per the National Electrical Code and shall meet all local and state codes.

B. Any cable associated with this Contract shall be rated, listed by a Nationally Recognized Testing Laboratory (NRTL) and marked for use in a plenum application, regardless if the

ceiling is a ducted return air plenum or not. Cable shall be CMP rated per the National Electrical Code and shall meet all local and state codes.

C. Voice copper backbone cables, if required, shall be twisted 24 AWG., contain a corrugated aluminum shield, be of the size indicated on the drawings and have the proper jacket classification per the NEC.

2.3 FACTORY ASSEMBLED PRODUCTS

A. Provide maximum standardization of components to reduce spare part requirements.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts, which are alike, shall be product of a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.

C. Components of equipment shall bear manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model. Exception will be permitted if performance requirements cannot be met.

2.4 COMPATABILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

B. Provide maximum standardization of components to reduce spare part requirements.

C. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike shall be product of a single manufacturer.
3. Components of equipment shall bear manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

2.5 LIFTING ATTACHMENTS

A. Equipment should have suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered without bending or distortion of shape, such as rapid lowering and braking of load.

2.6 MISCELLANEOUS SUPPORTS

A. Metal bars, plates, tubing, etc. shall conform to the following ASTM standards:

1. Steel plates, shapes, bars, and grating - ASTM A 36
2. Cold-Formed Steel Tubing - ASTM A 500
3. Hot - Rolled Steel Tubing - ASTM A 500
4. Steel Pipe - ASTM A 53, Schedule 40, welded

B. Metal Fasteners shall be Zinc-coated (type, grade and class as required)

2.7 FIRESTOPPING

A. Firestopping for Openings through Fire and Smoke Rated Walls and Floor Assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Firestop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Firestops" designated ASTM E814.

B. Inside of all conduits, the firestop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

C. All conduit and sleeve openings shall be waterproofed or fireproofed in compliance with Fire Codes. Strict adherence to National and State Fire Codes, particularly firestopping will be required.

D. All openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. shall be patched.

E. All building conduits and sleeves installed and/or used under this contract shall be firestopped, or re- firestopped, upon cable placement through such passageways.

F. Manufacturer's recommended installation standards must be closely followed (i.e. minimum depth of material, use of ceramic fiber and installation procedures).

G. Provide firestop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide firestop seal between sleeve and wall for drywall construction.

H. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the firestop system. The installation shall provide an air and watertight seal.

I. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:

1. Floors - 3 hours
2. Corridor walls - 2 hours
3. Offices - ¾ hour
4. Smoke partitions - ¾ - 1 hour

J. Provide firestop pillows for existing cable tray penetrations through firewalls.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Due to small scale of drawings, it is not possible to indicate all offsets, fittings, changes in elevation, etc. Verify final locations for installation with field measurements and with the equipment being connected. Verify exact location and elevations at work site prior to any rough in work. If field conditions, details, changes in equipment or shop drawing information require a significant change to the original documents, contact the owner's representative for approval before proceeding.

B. All equipment locations shall be coordinated with other trades, other renovation projects, and existing conditions to eliminate interference with required clearances for equipment maintenance and inspection.

1. Coordinate work with other trades, other renovation projects, and existing conditions to determine exact routing of all cable tray, hangers, conduit, etc., before fabrication and installation. Coordinate with Technology Drawings. Verify with Owners Representative exact location and mounting height of all equipment in finished areas, such as equipment racks, communication and electrical devices. Coordinate all work with existing Architecture.
2. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. There will be no priority schedule for trades. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required for ample maintenance space. Any changes in the size or location of the material or equipment supplied or proposed, which may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of the Owner's Representative and approval received before such alterations are made.

C. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation.

3.2 CUTTING AND PATCHING

A. Cut and drill from both sides of walls and/or floors to eliminate splaying. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering, other finished surfaces. Patch and/or paint openings and

damaged areas equal to existing surface finish. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

3.3 CONCEALMENT

A. Use existing conduit and surface raceway where possible and practicable. Conceal all contract work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, notify Owner's Representative before starting that part of the work and install only after his review. In areas with no ceilings, install only after Owner's Representative reviews and comments on arrangement and appearance.

3.4 CHASES

A. General

1. Field verifies for correct size and location for all openings, recesses and chase.
2. Assume responsibility for correct and final location and size of such openings.
3. Rectify improperly sized, improperly located or omitted chases or openings due to faulty or late information or failure to check final location.
4. Correct, by drilling, omitted or improperly located sleeves. Assume responsibility for all work and equipment damaged during course of drilling. Cap or firestop all unused conduits and sleeves.
5. Provide angle iron frame where openings are required for contract work.
6. Seal voids in fire rated assemblies with a firestopping seal system to maintain the fire resistance of the assembly. Provide 18 gauge-galvanized sleeves at fire rated assemblies. Extend sleeves 2" above floors.
7. In wall openings, drill or cut holes to suit. Provide 18 gauge galvanized sleeves at shafts and fire rated assemblies. Provide firestopping seal between sleeves and wall in drywall construction. Provide firestopping similar to that for floor openings.

3.5 WATERPROOFING

A. The Contractor shall seal all foundation penetrating conduits and all service entrance conduits and sleeves to eliminate the intrusion of moisture and gases into the building. This requirement also includes spare conduits.

B. Spare conduits shall be plugged with expandable plugs.

C. All service entrance conduits through building shall be sealed or resealed upon cable placement.

D. Conduits with cables in them shall be permanently sealed by firmly packing the void around the cable with oakum and capping with a hydraulic cement or waterproof duct seal.

3.6 SUPPORTS

A. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support contract work. Supports shall meet the approval of the Owner's Representative. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above. For precast Panels/Planks and Metal Decks, support communication work as determined by manufacturer and Owner's Representative. Provide heavy gauge steel mounting plates for mounting contract work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

3.7 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate ordering and installation of all equipment with long lead times or having a major impact on work by other trades so as not to delay the job or impact the schedule.

B. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible.

C. Set all equipment to accurate line and grade, level all equipment and align all equipment components.

D. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery of equipment and apparatus furnished into the premises. These items shall be removed from premises when no longer required.

E. No equipment shall be hidden or covered up prior to inspection by the owner’s representative. All work that is determined to be unsatisfactory shall be corrected immediately.

F. All work shall be installed level and plumb, parallel and perpendicular to other building systems and components.

3.8 IMPLEMENTATION

A. The contractor shall provide and install all hardware, software, connections and appurtenances required for fully operational systems.

END OF SECTION 270000

SECTION 270526 – GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This document describes the products and execution requirements relating to furnishing and installing Grounding/Earthing and Bonding for Communications Systems.

B. This section includes minimum requirements for the following:

1. Grounding/Earthing System.
2. Telecommunications Grounding Busbar (TGB).
3. Telecommunications Main Grounding Busbar (TMGB).
4. Telecommunications Bonding Backbone (TBB).
5. Rack Grounding/Earthing and Bonding.

C. All cables and related terminations, support and grounding/earthing hardware shall be furnished, installed, wired, tested, labeled, and documented by the General Contractor as detailed in this document and on the drawings.

D. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of grounding/earthing products, typical installation details and cable routing are provided on the drawings. If this document is in conflict, with the drawings the drawings take precedence. The successful vendor shall meet or exceed all requirements for the cable system described in this document.

1.2 REGULATORY REFERENCES

A. The following industry standards are the basis for the grounding/Earthing and bonding system described in this document.

1. TIA/EIA
   a. TIA-942 -A Telecommunications Infrastructure Standard for Data Centers
   b. ANSI-TIA-607-E - Commercial Building Grounding/Bonding Requirements
   c. TIA606-C- 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. NFPA
   a. NFPA-70 - National Electric Code (NEC)

B. The most recent versions of all documents apply to this project. If there is a conflict between applicable documents, the order above shall dictate the order of precedence in resolving the issue unless an enforceable local or national code is in effect.

1.3 QUALITY ASSURANCE

A. General Contractor Qualifications:

1. The General Contractor shall submit references and other related evidence of installation experience for a period of three years prior to the issue date of this Specification.
2. All work shall be supervised on-site by a BICSI Registered Communications Distribution Designer (RCDD). Person must demonstrate knowledge and compliance with all BICSI, TIA, UL, and NEC standards and codes. General Contractor shall submit proof of RCDD designation.

B. Provided products shall meet the following requirements: Items of the same classification shall be identical. This requirement includes equipment, assemblies, parts, and components.

C. Assure that the "as installed" system is correctly and completely documented including engineering drawings, manuals, and operational procedures in such a manner as to support maintenance and future expansion of the system.

1.4 DEFINITIONS

A. Bonding - The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed.

B. Common Bonding Network (CBN) - The principal means for affecting bonding and earthing inside a building.

C. Ground/Earth - A conducting connection, whether intentional or incidental, by which an electric circuit or equipment is connected to earth, or to some conducting body of relatively large extent that serves in place of the earth.

D. Retrofit Rack Grounding/Earthing - The application of grounding/earthing products and technology where equipment is already deployed and functioning.

1.5 OVERVIEW

A. The purpose of the grounding/earthing system is to create a low impedance path to earth ground for electrical surges and transient voltages. Lightning, fault currents, circuit switching (motors turning on and off), and electrostatic discharge are common causes of these surges and transient voltages. An effective grounding/earthing system minimizes the detrimental effects of these electrical surges, which include degraded network performance and reliability and increased safety risks.

B. The grounding/earthing system must be intentional, visually verifiable, adequately sized to handle expected currents safely, and directs these potentially damaging currents away from sensitive network equipment. As such, grounding/earthing must be purposeful in its design and installation.

C. Four issues require special consideration:

1. Although AC powered equipment typically has a power cord that contains a ground/earth wire, the integrity of this path cannot be easily verified. Thus, many equipment manufacturers require grounding/earthing above and beyond that which is specified by local electrical codes, such as the National Electrical Code, etcetera. Always follow the grounding/earthing recommendations of the manufacturer when installing equipment.
2. While the building steel and metallic water piping must be bonded to the grounding/earthing system for safety reasons, neither may be substituted for the telecommunications bonding backbone (TBB).
3. Electrical continuity throughout each rack or cabinet is required to minimize safety risks. Hardware typically supplied with bolt together racks is not designed for grounding/earthing purposes.
4. Additionally, most racks are painted. Paint is an insulator. Unless rack members are deliberately bonded, continuity between members is incidental, and in many cases, unlikely.

D. Any metallic component that is part of a data center or telecommunications room, including equipment, racks, ladder racks, enclosures, cable trays, etc. must be bonded to the grounding/earthing system with a 1 ohm resistance between 2 points.

1.6 WORKMANSHIP

A. The ground/earth system must be designed for high reliability. Therefore, the grounding/earthing system shall meet following criteria:

B. Local electrical codes shall be adhered to.

1. The grounding/earthing system shall comply with ANSI/TIA-942-A and J-STD-607-C.
2. All grounding/earthing conductors shall be copper.
3. Lugs, HTAPs, grounding strips, and busbars shall be UL Listed and made of premium quality tin-plated electrolytic copper that provides low electrical resistance while inhibiting corrosion. Antioxidant shall be used when making bonding connections in the field.
4. Wherever possible, two-hole lugs shall be used because they resist loosening when twisted (bumped) or exposed to vibration. All lugs shall be irreversible compression and meet NEBS Level 3 as tested by Telcordia. Lugs with inspection windows shall be used in all non-corrosive environments so that connections may be inspected for full conductor insertion (battery rooms are an exception where windowless lugs may be used).
5. Die index numbers shall be embossed on all compression connections to allow crimp inspection.
6. Cable assemblies shall be UL Listed and CSA Certified. Cables shall be a distinctive green or green/yellow in color, and all jackets shall be UL, VW-1 flame rated.

PART 2 - PRODUCTS

2.1 GROUNDING/EARTHING AND BONDING

A. The Telecommunications Grounding Busbar (TGB) in each telecommunications space will be grounded/earthed to the Telecommunications Main Grounding Busbar (TMGB) located at the service entrance. The gauge of the connecting ground/earth cable, known as the

Telecommunications Bonding Backbone (TBB) will follow J-STD-607-A guidelines, as is shown in the table below.

1.

Sizing of the TBB	
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
Greater than 20 (66)	3/0

B. The TMGB will be bonded to building steel and grounded/earthed to the electrical service ground according to BICSI TDM Manual and J-STD-607-C guidelines. Local codes may supersede these requirements. In telecommunications spaces with only one rack, the rack jumper cable can be connected directly to the TGB.

1.

Cable Sizes for Other Grounding/Earthing Applications	
Purpose	Copper Code Cable Size
Aisle grounds (overhead or under floor) of the common bonding net work	#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. equipment	6 AWG
Building columns	4 AWG
Cable ladders rack-trays	6 AWG
Conduit, water pipe, duct	6 AWG

2.2 COMPONENTS, KITS AND HARDWARE

A. STRUCTUREDGROUND™ Grounding System (STRUCTUREDEARTH™ Earthing System) kits, components, and hardware shall be used to construct the grounding/earthing system.

B. Use lugs when connecting conductors to the TMGB and TGB.

C. Route the TBB to each TGB in as straight a path as possible. The TBB should be installed as a continuous conductor, avoiding splices where possible. Use HTAP kits to provide a tap from the TBB to each TGB. When more than one TBB is used; bond them together using the TGBs on the top floor and every third floor in between with a conductor known as a Grounding Equalizer (GE). Use the J-STD-607-A guidelines for sizing of the TBB when sizing the GE (shown in the table above).

D. 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 a #6 AWG copper conductor to connect the GPL grounding clamp to the HTWC HTAP.

2.3 RACK GROUNDING/ EARTHING

A. Equipment, equipment racks and ladder rack shall be bonded in accordance with the methods prescribed in ANSI/TIA-942-A.

B. To provide electrical continuity between rack elements, paint piercing grounding washers, shall be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.

C. 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.

D. Do not bond racks or cabinets serially. Use the copper compression HTAP that comes with the kit to bond the conductor to the common bonding network. Grounding lugs shall be double holed.

PART 3 - PART 3 - EXECUTION

3.1 GROUNDING SYSTEM

A. The communications grounding system shall be designed and/or approved by a qualified PE licensed in the state that the work is to be performed. The communications grounding system shall adhere to the recommendations of the ANSI/TIA-942-A and J-STD-607-C standards, and shall be installed in accordance with best industry practice.

B. A General Contractor shall perform installation and termination of the main bonding conductor to the building service entrance ground.

C. A General Contractor shall perform installation and termination of the main Telecommunications Grounding Bus Barr.

END OF SECTION 270526

SECTION 270528 – PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. This Section includes the following:

1. Conduit, fittings and bodies, including multi-cell conduit.
2. Riser flexible raceway (inner duct) and fittings.
3. Junction boxes pull boxes and gutters.
4. Measured pull tape.
5. J-Hooks.
6. Wire Tray / Ladder Rack.

1.2 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. References:

1. American National Standards Institute (ANSI):
   a. C80.1 Rigid Steel Conduit - Zinc Coated.
   b. C80.4 Fittings for Rigid Metal Conduit.
2. Federal Specifications (FS):
   a. W-C-58C Conduit Outlet Boxes, Bodies Aluminum and Malleable Iron.
   b. W-C-1094 Conduit and Conduit Fittings Plastic, Rigid.
   c. WW-C-566C Flexible Metal Conduit.
   d. WW-C-581D Coatings on Steel Conduit
   e. National Electrical Manufacturers Association (NEMA):
   f. RN1 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Electrical metallic Tubing.
   g. TC2 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
   h. TC3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.
   i. NEMA VE 1 - Metal Cable Tray Systems.
   j. NEMA VE 2 - Metal Cable Tray Installation Guidelines.
3. American Society for Testing and Materials International (ASTM)

a. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
b. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.
c. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

4. Underwriters Laboratories Inc. (UL):
   a. 514 B Fittings for Conduit and Outlet Boxes.
   b. 651 Schedule 40 and 80 Rigid PVC Conduit.
   c. 651A Type EB and A Rigid PVC Conduit and HDPE Conduit.
   d. 1666 Standard for Riser Application for Optical Fiber Raceway.
5. National Fire Protection Association (NFPA) ANSI/NFPA 70 National Electrical Code (NEC).
6. ANSI/TIA-569-D-1, Telecommunications Pathways and Spaces
7. Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual (TDMM).
8. Local, county, state and federal regulations and codes in effect as of date of purchase.
9. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be
10. Indicate in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.3 SUBMITTALS

A. The Cable Contractor shall perform no portion of the work requiring submittal and review of record drawings, shop drawings, product data, or samples until the respective submittal has been approved by the Owner. Such work shall be in accordance with approved submittals.

B. Qualifications: The Cable Contractor shall submit qualification data sheets for firms and persons as specified in the "Quality Assurance" article of this specification to demonstrate their capabilities and experience.

C. Proposed product data sheets: The Cable Contractor shall submit catalog cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten and/or highlighted to indicate exact selection. Identify applicable specification section reference for each product.

D. Coordination Drawings: The Cable Contractor shall submit coordination drawings showing coordination between communications pathways and other trades.

E. Record Drawings: Furnish CAD drawings of completed work including cable ID numbers following the Owner's labeling standards. Submit in hardcopy (two full size and two half size) and electronic formats.

1.4 QUALITY ASSURANCE

A. Cable Contractor Qualifications:

1. The Cable Contractor shall submit references and other related evidence of installation experience for a period of three years prior to the issue date of this Specification.

2. All work shall be supervised on-site by a BICSI Registered Communications Distribution Designer (RCDD). Must demonstrate knowledge and compliance with all BICSI, TIA, UL, and NEC standards and codes. Cable Contractor shall submit proof of RCDD designation.

B. Provided products shall meet the following requirements: Items of the same classification shall be identical. This requirement includes equipment, assemblies, parts, and components.

C. Assure that the "as installed" system is correctly and completely documented including engineering drawings, manuals, and operational procedures in such a manner as to support maintenance and future expansion of the system.

1.5 WARRANTY

A. General Warranty: Refer to General and Special Provisions Document for warranty requirements.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

1.7 DELIVERY AND STORAGE

A. Equipment shall be delivered in original packages with labels intact and identification clearly marked.

B. Equipment shall not be damaged in any way and shall comply with manufacturer’s operating specifications.

C. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.

1.8 COORDINATION

A. Field coordinate installation of conduit and cable tray with other trades to ensure clearance requirements are met.

B. Coordinate with all contractors providing equipment outside the scope of this contract.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Definition:

1. For the purpose of this document, the term “Telecommunication Pathways” defines a portion of the communication infrastructure. Telecommunication Pathways include products provided for the routing, segregation and support of telecommunication cabling both inside and outside of facilities.

B. Primary Industry Standard Requirements for Telecommunication Pathways:

1. Comply with ANSI/TIA-569-D-1

2.2 J-HOOKS

A. J-Hooks shall be the secondary pathway for cable distribution from TRs to work outlets:

1. Comply with ANSI/TIA-569-D-1.
2. J-Hooks shall be sized to accommodate known cable load and provide for 100% expansion.
3. J-Hooks shall be attached directly to the building structure and shall not be supported by any other building systems such as electrical conduits, HVAC duct work, and plumbing or sprinkler pipe.
4. Comply with the requirements of all related NEMA, ASTM and BICSI standards.

2.3 CONDUIT SYSTEMS

A. Conduit pathways shall be provided by the electrical contractor as complete Conduit systems including:

1. Conduit with pull strings.
2. Pull box / Junction box assemblies (provided after 180 degrees of bends and/or 100’ on continuous run).
3. Mounting / attachment hardware.
4. Labeling.
5. Grounding.

B. Conduit Fill Calculations.

1. Calculate and provide conduit systems with sizing and quantities to assure conduit wire/cable fill does not exceed pulling tensions, rush limits and performance properties of cables installed.

C. Conduit Trade Sizes

1. Typical conduit trade sizes used in Inside Plant Telecommunication Pathways are:

a. Trade Size 3/4Inch EMT.
b. Trade Size 1 Inch EMT (Minimum Conduit size without written exception by OAT Engineer).
c. Trade Size 1 Inch EMT.
d. Trade Size 2 Inch EMT.
e. Trade Size 3 Inch EMT.
f. Trade Size 4 Inch EMT.
g. Various trade size “Flex” conduit (typically limited to 6 feet in length).

2.4 FIRESTOPPING

A. Fire stopping shall be provided for Telecommunication Pathways at penetration areas for fire rated walls and floors. Fire stopping shall meet or exceed the hour rating of wall or floor penetrated by the Telecommunication Pathway.

1. Fire stopping shall comply with latest release of NEC NFPA 70.
2. Fire stopping products and applications shall provide containment of smoke, fumes and flame with performance in accordance with ASTM E814-00 and UL 1479.
3. Local Authority Having Jurisdiction -Building Code Requirements.

B. Types of Fire stopping hardware and materials include:

1. Mechanical Fire stopping Products Conduit Sleeves
   a. Conduit Sleeves.
   b. Cable Tray Penetrations.
   c. Penetration Frame Products.
2. Non-Mechanical Fire stopping Products:
   a. Putties.
   b. Caulks.
   c. Cementitious / Foams / Intumescent Materials.
   d. Prefabricated Pillows, Blocks and Blankets.
3. Fire stopping products shall be installed per manufacturer’s practices.
4. Manufactures include:
   a. Specified Technologies Inc. (STI) SpecSeal
   b. 3M Products.
   c. CSD Sealing Systems.
   d. Approved Equal.

2.5 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2. Ground Bus Bar: Each communication room depicted in the drawings shall be provisioned with a Telecommunications Grounding Busbar (TGB) meeting or exceeding the following requirements:
   a. Each bar shall be installed with isolated standoff mounts.
   b. Minimal bar size is %" thick x 2" wide x 10" long.
   c. The TGB's shall be electroplated and pre-drilled for connector attachment to 6 AWG ground cables.
   d. Holes spaced 1-1/8 inches apart.

C. A #6 AWG stranded copper wire cable shall be extended between Telecommunication Room (TR) Busbars (TGB) and the Telecommunications Main Grounding Busbar (TMGB) (located in MDF) via conduit and cable tray systems as shown on the drawings.

D. Ground conductor shall be provided, installed and utilized for equipment, termination, cable tray, equipment rack and computer equipment grounding, including telephone systems.

E. All grounding material and work shall comply with the National Electric Code (NEC Chapter 8), Local and State regulations as well as ANSI-J/STD-607-C.

F. Coordinate with the electrical power trades for grounding wiring interface to an approved connection to the building electrical power service panel ground source. Provide #6 AWG stranded copper bonding conductor extending from the electrical ground source to the Telecommunication Main Grounding Busbar (TMGB) located in the MDF.

G. Provide ground cable #6 AWG stranded copper bonding conductor installed from the TMGB to each of the TR's as depicted in the project drawings ground wiring riser diagram. No Daisy-chaining allowed.

H. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line P/N: SB-477or equal.

2.6 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 "Identification for Electrical Systems."

2.7 MANUFACTURERS

A. A. Subject to compliance with requirements, manufacturers that may be incorporated in the work, include, but are not limited to the following:

1. PVC Rigid Conduit:
   a. Carlon.
   b. Robroy Industries, Inc.
   c. Cantex.

d. Or equal.

2. Conduit Fittings and Bodies:
   a. Crouse-Hinds, Appleton Electric.
   b. Killark Electric Manufacturing Company.
   c. O-Z/Gedney.
   d. Or equal
3. J-HOOKS:
   a. Erico/Caddy.
   b. Or equal.
4. Measured pull tape - pull tape printed with sequential footage markings for accurate measurements:
   a. Fibertek.
   b. Condux International.
   c. Or equal.

2.8 MATERIALS

A. Conduits

1. All conduits, fittings, junction and pull boxes shall be UL rated.
2. All conduits, fittings, junction and pull boxes shall comply with the NEC.

B. Non-metallic conduits are not permitted in above ground installations. Conversion fittings are required for non-metallic (below ground) to metallic (above ground) transitions. Exceptions will be granted to accommodate the transition from outside plant to inside plant to comply with code requirements

C. Measured Pull Tape

1. Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn
2. Minimum average tensile strength shall be 1250 lbs. for 1%-inch and smaller conduits and inner duct.
3. Minimum average tensile strength shall be 1800 lbs. for conduits larger than 1% inch.

D. Pull Boxes, Junction Boxes and Gutters

1. All junction boxes, gutters and pull boxes shall comply with NEC Article 314.
2. All junction boxes, gutters and pull boxes shall meet the following minimum material requirements:
   a. 16-gauge steel or heavier.
   b. Seams shall be continuously welded and grounded smooth.
   c. External screws and clamps.
   d. External mounting feet (where possible).
   e. Oil-resistant gasket and adhesive.
   f. ANSI 61 gray polyester powder coating inside and out over phosphatized surface.
   g. UL 50 type 12.
3. All junction boxes, gutters and pull boxes shall be provided with bushings for conduits and/or cabling.
4. All junction boxes, gutters and pull boxes shall be securely installed.

5. All junction boxes, gutters and pull box sizes for single and multiple conduit runs shall comply with BICSI TDMM.

E. CABLE BASKET, CABLE TRAY and LADDER RACK

1. Rated for use with Category 6a cable
2. Sized for support of quantity of cable installed at each location
3. Metallic and/or plenum rated.

F. J-HOOKS

1. Rated for use with Category 6a cable
2. Installed as shown in drawings
3. Metallic and/or plenum rated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cable Contractor's on-site RCDD supervisor shall review, approve and stamp all shop drawings, coordination drawings and record drawings.

B. Verify conduit system is properly sized for cables (minimum one inch, unless otherwise noted in Drawings).

C. Verify general conduit route following Drawings.

D. Verify substrates to which work is connected and determine detail requirements for proper support.

E. Verify proper location andtype of rough-in for conduit terminations.

3.2 INSTALLATION

A. Coordinate locations with other trades prior to installation.

B. Install work following drawings, manufacturer's instructions and approved submittal data.

C. Installation plans and requests for information (RFIs) shall be reviewed by Cable Contractor's on-site RCDD.

D. All work shall be supervised and reviewed by Cable Contractor's on-site RCDD.

E. Locations and Types:

1. J-HOOKS
   a. Install J-Hooks directly to building structure. Hooks may not be supported by any other building system - e.g. HVAC ducts, electrical conduits, plumbing or ceiling supports.

b. J-Hooks shall be installed every 48".
c. J-Hooks must be install straight level & plumb.
d. Cables shall be neatly bundled and secured to hooks using Velcro or Velcro type straps or fasteners.
e. Cable Contractor's RCDD supervisor shall coordinate with drawings of other disciplines to determine availability of space for installation.

2. CABLE TRAY/ LADDER RACK
   a. Install cable tray in telecomm closets as depicted on drawings
   b. Position, elevation and routing of cable tray shall be coordinated with GC to ensure there is no conflict with equip-net furnished and installed by any other contractor on site (e.g. HVAC, Electrical, Plumbing etc.)
   c. Cable tray shall be secured directly to building structure and not supported by any other equipment or service element (e.g. ceiling grid, black iron, HVAC supports etc.)
   d. Ladder within the telecommunications rooms (MDF, IDF) may be supported to the above the equipment racks within these rooms.
   e. Support system shall be straight, level and plumb and show no signs of sagging or drooping at any point.
   f. Cables in these trays shall be neatly bundled and secured using Velcro straps ONLY
   g. All tray and ladder rack shall be grounded according to NEMA, BICSI and local jurisdiction requirements
   h. Cable Contractor's RCDD supervisor shall coordinate with drawings of other disciplines to determine availability of space for installation.
3. CABLE BASKET
   a. Install cable basket in hallway ceilings as depicted on attached drawings telecomm closets as depicted on drawings
   b. Position, elevation and routing of cable basket shall be coordinated with GC to ensure there is no conflict with equipment furnished and installed by any other contractor on site (e.g. HVAC, Electrical, Plumbing etc.)
   c. Cable basket shall be secured directly to building structure and not supported by any other equipment or service element (e.g. ceiling grid, black iron, HVAC supports etc.)
   d. Support system shall be straight, level and plumb and show no signs of sagging or drooping at any point.
   e. Cables in these baskets shall be neatly bundled and secured using Velcro straps ONLY
   f. All Cable basket shall be grounded according to NEMA, BICSI and local jurisdiction requirements
   g. Cable Contractor's RCDD supervisor shall coordinate with drawings of other disciplines to determine availability of space for installation.

F. Design Considerations:

1. Conduit fill shall comply with ANSI/TIA -569-D.
2. The minimum bend radius is six times the conduit inside diameter (ID) for a two inch conduit or less.
3. The minimum bend radius is 10 times the conduit ID for a conduit greater than two inches.
4. Below grade conduit shall extend three inches above finished floor (AFF) with a bushing.
5. Ceiling conduit or sleeves shall extend six inches below finished ceiling with a bushing.

6. All stubbed conduit ends shall be provided with a ground bushing.
7. All conduit penetrations shall comply with all applicable fire codes. All conduit penetrations in fire-rated walls or floors shall be sealed and fire proofed to at least the rating of the penetration area.
8. Conduits shall be routed in the most direct route, with the fewest number of bends possible.
9. There shall be no continuous conduit sections longer than 100 feet. For runs that total more than 100 feet, insert junction or pull boxes (or gutters if appropriate) so that no continuous run between pull boxes is greater than 100 feet.
10. There shall be no more than two 90-degree bends (180 degrees total) between conduit pull boxes.
11. Changes in direction shall be accomplished with sweeping bends observing minimum bend radius requirements above. Do not use pull boxes for direction changes unless specifically designated otherwise in the Drawings.
12. Unless otherwise noted in the Drawings, conduits entering pull boxes shall be aligned with exiting conduits.

G. Identification: Refer to Section 270553 Identification for Communications Systems for labeling requirements.

3.3 CLEANING

A. Remove all unnecessary tools and equipment, unused materials, packing materials and debris from each area where Work has been completed unless designated for storage.

3.4 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted and approved, and the Owner is satisfied that all work has been completed in accordance with contract documents; the Owner will notify Cable Contractor in writing of formal acceptance of the system.

B. Acceptance shall be subject to completion of all work and submittal and approval of full documentation as described above.

END OF SECTION 270528

SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

A. This Section includes labeling and identification standards for:

1. Horizontal and backbone cabling and termination hardware
2. Conduits and pathways
3. Equipment cabinets, racks, frames and enclosures

B. As-builts shall contain matching label information

1.2 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. References:

1. ANSI/TIA -606-C Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
2. International Standards Organization/International Electromechanical Commission (ISO/IEC) DIS11801, January 6, 1994
3. Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDMM)
4. Local, county, state and federal regulations and codes in effect as of date of purchase.
5. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin

1.3 SUBMITTALS

A. Product Data:

1. The Contractor shall submit catalog cut-sheets that include manufacturer, trade name, and complete model number for each product specified.

2. Model number shall be handwritten and/or highlighted to indicate exact selection. Identify applicable specification section reference for each product.

B. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

1.4 QUALITY ASSURANCE

A. Provided products shall meet the following requirements: Items of the same classification shall be identical. This requirement includes equipment, assemblies, parts, and components.

B. Assure that the "as installed" system is correctly and completely documented including engineering drawings, manuals, and operational procedures in such a manner as to support maintenance and future expansion of the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers that may be incorporated in the work, include, but are not limited to the following:

B. Labels and Labeling System

1. Basis of Design: Brady
2. Acceptable substitutes: Dymo, Belden or submitted and Approved equal

2.2 GENERAL REQUIREMENTS

A. All telecommunication components, areas, and cables shall be labeled, including but not limited to:

1. Fiber cables.
2. Metallic cable.
3. Ground points.
4. Cross-connect fields.
5. Exterior enclosures.
6. Conduit ends (pathways).
7. Pull boxes and junction boxes.
8. Equipment racks and cabinets.
9. Fiber patch panels
10. Maintenance holes.
11. Cables in maintenance holes and pull boxes.
12. Patch cables/jumpers.

B. Pathways are defined but not limited to; any conduit, innerduct, underground duct bank, wiring troughs, pull boxes, and any wiring systems used to enclose cabling of any type.

C. All label material shall be suitable for intended usage and environment, meeting the legibility, defacement and general exposure requirements listed in UL 969 for indoor and outdoor use. Where insert labels are used, the insert label shall be covered with clear cover and securely held in place.

D. Interior labeling: printer shall be of the thermal transfer type capable of printing self-laminating labels of various size up to and including 1.5”by 1.5” printable area with a 4.5” self-laminating tail. No non-self-laminating labels shall be approved.

E. All labels shall be permanent, i.e. will not fade, peel, or deteriorate due to environment or time.

F. Handwritten labels are not acceptable.

2.3 CONDUITS AND PATHWAYS

A. Conduits: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive, trade name, “Mondo Bondo” (Brady). Label size shall be appropriate for the conduit size. Font size shall be easily visible from the finished floor.

B. Innerduct: Polyethylene general-purpose tagging material

1. Brady part number PTL-12- 109 (.75 X 3.00) used with an R4310 ribbon. This tag shall be attached using tie wraps.

C. Junction boxes (larger than four-inch x four-inch): General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive, trade name, “Mondo Bondo”, Brady part number PTL-43-483 (1.90 X continuous) used with an R6010 ribbon. Font size shall be easily visible from the finished floor.

D. Junction boxes (four-inch x four-inch): General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive, trade name, “Mondo Bondo”

1. Brady part number PTL-42-483 (1.00 X continuous) used with an R6010 ribbon.

2.4 BACKBONE AND HORIZONTAL CABLE AND TERMINATIONS

A. Fiber termination hardware (cover): General purpose label designed for powdered coated surfaces, trade name, “Mondo Bondo”

1. Brady part number PTL-42-483 (1.00 X continuous) used with an R6010 ribbon.

B. Fiber termination hardware (designation strip): Thermal transfer printable label with a permanent acrylic adhesive

1. Brady part number PTL-10-423 (.75 X .25) used with an R6010 ribbon.

C. Patch panels: Gloss white film with a permanent acrylic based adhesive

1. Brady part number PTL-39-422 (.375 X .60) used with an R6010 ribbon.

D. Inside and outside plant fiber cables: Permanent acrylic adhesive, self-laminating vinyl wire and cable identification

1. Brady part number PTL-33-427 (1.50 X 4.00 X 1.00) used with an R4310 ribbon.

2.5 EQUIPMENT RACKS AND CABINETS

A. General purpose label designed for powdered coated surfaces.

B. Basis of Design: Trade name, “Mondo Bondo”,

1. Brady part number PTL-42-483 (1.00 X continuous) used with an R6010 ribbon.

PART 3 - EXECUTION

3.1 GENERAL

A. Labeling format shall be as shown in Telecommunications Drawings Set.

3.2 CONDUITS AND JUNCTION/PULL BOXES

A. All conduits, innerduct, junction boxes, gutters and pull boxes shall be labeled.

B. Conduits shall be labeled with the word “communications” and the conduit’s origination room number and destination room number. Permanent room identifiers shall be used.

C. Label conduit every 50 feet, at each wall and floor penetration and at each conduit termination, such as outlet boxes, pull boxes, and junction boxes, or as otherwise specified in other Sections.

D. Junction boxes, gutters and pull boxes shall be labeled with identification name or number as determined by Contractor and submitted for approval.

E. Labels on conduits, junction boxes, gutters and pull boxes shall be machine-generated and easily visible from the finished floor.

3.3 FIBER TERMINATIONS

A. Label cable terminations on designation strips.

B. Label all cable at each terminating point.

C. Labels shall be self-adhesive and machine generated.

D. Handwritten labels are not acceptable

E. Cable identification numbers shall not be duplicated.

F. Three copies of a cable record document containing the cable information required on the cable label shall be delivered to the GOAA Telecommunications Department.

3.4 EQUIPMENT RACKS AND CABINETS

A. All racks and cabinets shall be properly labeled with permanent typewritten labels, easily visible from finished floor.

B. Label as indicated in Drawings.

3.5 CLEANING

A. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.

3.6 ACCEPTANCE

A. Once all work has been completed and the Owner is satisfied that all work has been completed in accordance with contract documents, the Owner will notify Contractor in writing of formal acceptance of the system.

B. Acceptance shall be subject to completion of all work and submittal and approval of full documentation as described above.

END OF SECTION 270553

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SECTION 270813 – TESTING COPPER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered by this section of the Specifications includes all labor necessary to perform and complete such construction, all materials and equipment incorporated or to be incorporated in such construction and all services, facilities, tools and equipment necessary or used to perform and complete such construction. The work of this section shall include, but is not limited to, the following:

1. Cable testing for copper cables.
2. Providing testing results in accordance with the strictest manufacturer written recommendations.

1.2 QUALITY ASSURANCE

A. Refer to Section 27 00 00 for general details.

1.3 CODES, STANDARDS AND GUIDELINES

A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations in Section 27 00 00.

1.4 SUBMITTALS

A. Refer to Section 27 00 00 for general details.

B. Submit Manufacturer’s Cut Sheets for the following:

1. Any products not specifically listed in the PRODUCTS section shall require a submittal of the manufacturer’s cut sheets.

C. List of test equipment to be used.

D. Sample of test data to be provided to the campus representative at the completion of testing.

E. Identity and qualifications of Contractor's personnel who will perform the testing.

F. Submit the proposed schedule for performing testing at least 2 weeks prior to the start of testing.

1.5 IDENTIFICATION

A. Refer to Section 27 05 53 for general details.

1.6 WARRANTY

A. Refer to Section 27 00 00 for general details.

PART 2 - PRODUCTS

2.1 CATEGORY 6 UTP CABLE TESTER

A. Testing for all cables 25 pair or larger are to use a tester that tests 25 pair at a time.

B. The field tester must meet the requirements of ANSI/TIA/EIA-568.

C. Make and model at Contractor's discretion.

2.2 MULTIMETER

A. Make and model at Contractor's discretion.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall test, as described below, all metallic cables installed under these specifications.

B. Visually inspect all cables, cable reels, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.

C. Where post-manufacturer test data has been provided by the manufacturer on the reel or shipping carton: submit copies to the campus representative prior to installing cables.

D. Test fully completed systems only. Piecemeal testing is not acceptable.

E. Testing shall not be performed until after all hardware is installed and attached, and all labeling and identification has been completed.

F. Any cable that does not pass all required testing shall be removed, replaced, and retested.

G. Remove and replace any defective cables from pathways system. Do not abandon cables in place.

H. The telecommunications representative reserves the right to observe all portions of the testing process.

I. The telecommunications representative further reserves the right to conduct "Proof of performance testing", using Contractor equipment and labor, a random re-test of up to ten percent (10%) of the cable plant to confirm documented test results.

J. Perform all tests as required by the manufacturer in support of the structured cabling system warranty.

3.2 GROUNDING & BONDING

A. All grounding and bonding is to be complete before any system testing is to be attempted.

3.3 TESTING

A. All test results are to be defined as acceptable / unacceptable by the requirements of ANSI/TIA/EIA-568 B.2.

B. Copper Cables – General Requirements

1. After terminating and splicing the cables. Test all cable pairs for:

a. Continuity to the remote end.
b. Shorts between any 2 or more conductors or ground
c. Transposed pairs
d. Reversed Pairs
e. Split Pairs
f. Crossed Pairs
g. Wire map.
h. Length.
i. Shield Continuity (If Shielded)
j. Continuity to Grounding (If Shielded)

2. Using a multimeter, test continuity to ground (TGB or TMGB) for a maximum resistance of 1Ω, see section 27-05-26 for additional detail.

C. Indoor Riser or OSP Copper Cable

1. After terminating and splicing the cables. Test all cable pairs for:

a. DC Loop Resistance for any 2 conductors in the cable

D. Category 6A Copper Station Cables:

1. Contractor is to perform a three connector permanent link test.

2. After terminating both ends of all 4-pair cables, but before any cross-connects are installed, test these cables for the following:

a. Return Loss
b. Insertion Loss
c. Attenuation
d. NEXT (near-end crosstalk)
e. PSNEXT (power sum near-end crosstalk)
f. FEXT (far end crosstalk)
g. ACR-F (attenuation to crosstalk ratio)
h. PSACR-F (power sum attenuation to crosstalk ratio)
i. Propagation delay

j. Delay skew

3.4 ACCEPTANCE

A. All test results for Cat 3 cable are to be documented and submitted in Microsoft Excel or .csv format to the campus telecommunications representative within five (5) working days of test completion.

B. All test results for Cat 6A cable are to be documented and submitted in Fluke LinkWare format to the campus telecommunications representative within five (5) working days of test completion.

C. Test result shall be recorded per cable and identical copies placed on three removable media devices (CD or DVD) for delivery to the campus project manager and campus telecommunications representative.

D. Each test report shall contain the following general information:

1. Date of Preparation
2. Date of Test
3. Project Name
4. Contractor's Name
5. Media Type
6. Make, Model and Serial Number of test equipment used
7. Date of Last Calibration
8. Names of Test Crew.

E. In addition to the results of the specific tests specified, reports shall also include:

1. Cable Number
2. Cable Type
3. Pair or Conductor Count
4. Individual Pair or Conductor Numbers,
5. Results of Each Test for Each Pair or Conductor
6. Total Number of Serviceable Pairs or Conductors in Cable.
7. Ground Resistance Measurements

F. Once the testing has been completed and the telecommunications representative is satisfied that all work is in accordance with the Contract Documents, the representative will notify the Contractor and/or project manager in writing or via email.

END OF SECTION 280813

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SECTION 271000 STRUCTURED CABLING

PART 1 - GENERAL

1.1 REFERENCES

A. All work shall be performed in accordance with the following Codes and industry Standards, unless noted otherwise:

1. NFPA 70 - National Electrical Code, current version adopted by local or State AHJ.
2. ANSI/TIA-568.0-D Generic Telecommunications Cabling for Customer Premises
3. ANSI/TIA-569-D-1, Telecommunications Pathways and Spaces.
4. ANSI/TIA-606-C, Administration Standard for Commercial Telecommunications Infrastructure.
5. ANSI/TIA-607-E, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
6. IEEE 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings, pertaining to communication systems.

1.2 WARRANTY

A. The Cable Contractor must be an approved Certified Installer. The Cable Contractor is responsible for workmanship and installation practices in accordance with the Manufacture Certified Installer or Partner Alliance (PA) program offering a 25 year warranty issued to the end user. The Cable Contractor shall have 30% of their technicians trained on fiber and copper installations and testing; they also shall have at least 1 project manager successfully complete a Manufacture 2-Day Management Certification class. Painting or paint overspray will void the warranty. The Telecommunications Contractor shall ensure that the General Contractor and Painting Contractor acknowledge that painting of or over spray any single or group of 4 pair horizontal telecommunications Category 6A cable is not allowed. Any painted or over sprayed cable(s) shall be replaced at the painting contractor's expense. Painted Cable will not be covered as part of an extended warranty. Painted cable in addition to obscuring the print legend may act as an accelerant or create an additional smoke hazard in the event of a fire and as such this is considered a life safety issue.

1.3 SUMMARY

A. This Section includes general requirements specifically applicable to Division 27.

1. Work Specifically Excluded from Project:
2. Materials provided by the owner as identified in the Contract Documents.

B. The Cable Contractor shall be responsible for:

1. Providing all additional materials, and the necessary labor and services required to ensure all components of the system are completely installed in accordance with the intent of the Contract Documents.
2. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.
3. Coordinating the details of facility equipment and construction for all specification divisions that affect the work covered under this Division.
4. Coordinating all activities with the overall construction schedule.
5. Developing bill of materials, perform material management and efficient use of the materials whether they are issued by the Cable Contractor, the owner or purchased by the Cable Contractor.
6. Ensure materials in excess of those required to complete the project are kept in their original condition and packaging for restocking.
7. Ensure project is properly registered for a warranty.
8. Furnish and install fire stopping for all fire rated penetrations or as required by AHJ.
9. Ensure entire system is installed in compliance with all applicable Federal, State and local codes and standards. The more stringent codes and standard shall take precedence.

C. Intent of Drawings:

1. Communications plan drawings show only general locations of equipment, devices, raceways, cable trays, boxes, etc. All dimensioned locations and elevations are approximate. The Cable Contractor is responsible for the field coordination of communications work with the other trades prior to beginning work.
2. The Cable Contractor shall be responsible for the proper placement and routing of equipment, cable, raceways, cable tray, and related components; according to the Contract Documents and subject to prior review by Cable Contractor.
3. Refer all conflicts between Contract Documents to Cable Contractor for resolution.

1.4 DEFINITIONS

A. Active Equipment: Electronic equipment used to develop various WAN and LAN services.

B. Backbone: Collective term sometimes used to describe the campus and vertical distribution subsystem facilities and media interconnecting service entrances, communications rooms, and communications cabinets.

C. Bonding: Permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed on it.

D. Main Distribution Frame (MDF): Room in each building used to distribute communications services to Intermediate Distribution Frame (IDF) in the same building. Typically, the MDF contains passive equipment used for electrical protection (protectors) and building cross connect, and active network equipment used for LANs. The IDF may also serve the function of an IDF.

E. Cabinet: Freestanding, floor-mounted modular enclosure designed to house and protects rack - mounted electronic equipment.

F. Cable Tray: Vertical or horizontal open supports usually made of aluminum or steel that is fastened to a building ceiling or wall. Cables are laid in and fastened to the trays. A cable tray is not a raceway.

G. Campus: Grounds and buildings of a multi-building premises environment.

H. Channel: The end-to-end transmission path between two points at which application specific equipment is connected; may include one or more links, cross-connect jumper and/or patch cords, and work area station cords. Does not include connection to active equipment.

I. Communications Equipment Room -See IDF Drawings.

J. Cross-Connect: Equipment used to terminate and tie together communications circuits.

K. Cross-Connect Jumper: A cluster of twisted-pair conductors without connectors used to establish a circuit by linking two cross-connect termination points.

L. Fiber Optic Distribution Unit (FDU): Cabinet with terminating equipment used to develop fiber optic cross-connect facilities.

M. Grounding: A conducting connection to earth, or to some conducting body that serves in place of earth.

N. Hinged Cover Enclosure: Wall-mounted box with a hinged cover that is used to house and protect electrical devices.

O. Horizontal: Pathway facilities and media connecting IDF to Telecommunications Outlets (TO).

P. Jack: Receptacle used in conjunction with a plug to make electrical contact between communications circuits, e.g., eight-position/eight-contact modular jacks.

Q. Link: A transmission path between two points, not including terminal equipment, work area cables, and equipment cables; one continuous section of conductors or fiber, including the connecting hardware at each end.

R. Local Area Network (LAN): Data transmission facility connecting a number of communicating devices, e.g., serial data, Ethernet, token ring, etc. Typically, the network is limited to a single site.

S. Main Equipment Room (MER): The room used to distribute communication services to all MDF’s on the premises, and to interconnect premises services with the telephone companies.

T. Media: Twisted-pair, fiber optic cable or cables used to provide signal transmission paths.

U. Mounting Frame: Rectangular steel framework which can be floor or wall mounted to support wiring blocks, patch panels, and other communications equipment.

V. Passive Equipment: Non-electronic hardware and apparatus, e.g., equipment racks, cable trays, electrical protection, wiring blocks, fiber optic termination hardware, etc.

W. Patch Cords: A length of wire or fiber cable with connectors on one or both ends used to join communications circuits at a cross-connect.

X. Patch Panel: System of terminal blocks or connectors used with patch cords that facilitate administration of cross-connect fields.

Y. Pathway: Facility for the placement of communications cable. A pathway facility can be composed of several components including conduit, wireway, cable tray, surface raceway, underfloor systems, raised floor, ceiling support wires, etc.

Z. Protectors: Electrical protection devices used to limit foreign voltages on metallic communications circuits.

AA. Raceway: An enclosed channel designed expressly for holding wires or cables; may be of metal or insulating material. The term includes conduit, tubing, wire way, underfloor raceway, and surface raceway; does not include cable tray.

BB. Racks: An open, freestanding, floor-mounted structure, typically made of aluminum or steel, used to mount equipment; usually referred to as an equipment rack.

CC. Telecommunication Outlet (TO): Connecting device mounted in a work area used to terminate horizontal cable and interconnect cabling with station equipment.

DD. IDF: Distributes communications services to users within a serving zone and interconnects with the BER. Typically, the TER contains passive equipment used for cross connect and active network equipment used for LANs. TR is sometimes referred to as the communications equipment room.

EE. Wide Area Network (WAN): Active communications transmission facilities extending beyond the premises.

FF. Wiring Block: Punch down terminating equipment used to develop twisted-pair cross connect facilities.

1.5 SYSTEM DESCRIPTION

A. The owner will implement a comprehensive integrated communications distribution system, as described in paragraph B below, to provide wiring infrastructure which may be used to support one or more of the following services and systems:

1. Data telecommunications.
2. Wireless systems.
3. Facilities management systems.
4. Mass Notification.
5. Paging.
6. Life Safety.

B. The communications distribution system consists of the following major subsystems, as specified elsewhere:

1. Intra-Building Backbone: The inter-building subsystem refers to all twisted pair and fiber optic backbone communications cabling connecting the MDF to IDFs in separate buildings.
2. Communication Rooms: The communications room contains the distribution subsystem comprised of the passive components used to terminate cabling subsystems and distribute communications services. This subsystem includes installations in the MDF, in IDF and Telecommunications Enclosures (TEs). Constructed as specified in Section 271100.
3. Horizontal Distribution: The horizontal distribution subsystem refers to all intra-building twisted-pair and fiber optic communications cabling connecting IDF's to telecommunication outlets (TOs) located at individual work areas. Constructed as specified in Section 271500.
4. Work Area Distribution Subsystem: Patch cords, adapters, and devices located between the TO and station equipment. Constructed as specified in Section 271600.

C. The communications distribution system is based on a combination of the following communications transmission technologies:

1. 100-ohm 4-pair unshielded twisted-pair cable 500MHz (CAT6A).
2. 8-position telecommunications jacks.
3. 8-position telecommunications patch panels (CAT6A).
4. Insulation displacement connector (IDC) type field terminated wiring blocks.
5. Factory Terminated copper patch cords.

D. The work locations and limits of work are shown on the drawings.

1.6 DESIGN CRITERIA

A. Compliance by the Cable Contractor with the provisions of this specification does not relieve him of the responsibilities of furnishing materials and equipment of proper design, mechanically and electrically suited to meet operating guarantees at the specified service conditions.

B. The following are incorporated into the design:

1. The location of communication rooms is intended to restrict the maximum horizontal subsystem wiring length (defined as a channel between a telecommunications room cross-connect termination field and a served TO) to 295 feet (90 meters).

1.7 WARRANTY

A. The Cable Contractor shall provide a manufacturer's warranty on the horizontal systems as specified in Section 271500.

B. In addition to the standard warranty requirements, the Certified Contractor shall provide the following during the warranty period:

1. Within 24 hours after notification of a defect, the Certified Contractor shall start to make the necessary corrections and inform the appropriate Project Manager of the planned corrective actions. The Certified Contractor shall follow this initial contact with continuous effort and complete any required corrective work within 15 days after notification.

1.8 QUALIFICATIONS

A. Communications Pathway Installation: The Cable Contractor shall have 5 years of documented experience installing raceway and cable tray systems for each of the types and system material components specified in the Contract Documents, e.g., underground duct banks, cable tray, etc. In the case of newer technologies that do not have a 3-year history, the Cable Contractor shall have documented experience for at least half of the lifetime of the new technology.

B. The Cable Contractor selected for this project must be certified by the manufacturer of the products (Panduit/General) adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this project.

C. The Cable Contractor must be an approved Certified Installer for the system bid. The Cable Contractor is responsible for workmanship and installation practices in accordance with the Certified Installer. The certified contractor shall have 30% of their technicians trained on copper & fiber installations and testing; they also shall have at least 1 project manager successfully complete a 2-Day Management Certification class.

D. Company certificate & letter from manufacturer stating certification is in good standing, shall be included with submittal.

E. Certified Installer must register project with Manufacture and must provide a warranty on the installation workmanship & testing for a length of twenty-five (25) years.

F. The Cable Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The Cable Contractor shall own and maintain tools and equipment necessary for successful installation and testing of both fiber optic and Category 6A premise distribution systems and have personnel who are adequately trained in the use of such tools and equipment.

G. A resume of qualification shall be submitted with the Cable Contractor's proposal indicating the following:

1. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
2. A technical resume of experience for the Cable Contractor's Project Manager and on-site installation supervisor who will be assigned to this project.
3. A list of technical product training attended by the Cable Contractor’s personnel that will install the structured cabling system shall be submitted with the response.
4. Any sub-contractors, who will assist the Certified Contractor in performance of this work, shall have the same training and certification as the Certified Contractor.

1.9 SUBMITTALS

A. General:

1. Provide ongoing inspection and permit certificates and certificates of final inspection and acceptance from the authority having jurisdiction.
2. Manufacturer's standardized schematic diagrams and catalog cuts shall not be acceptable unless applicable portions of same are clearly indicated and non-applicable portions clearly deleted or crossed out.
3. When the specifications include product descriptions, model numbers, part numbers, etc. that have been superseded, changed, or discontinued, the Cable Contractor shall submit a comparable substitution for review by the A/E.

B. Provide all applicable portions of the following information with the Bid:

1. Documentation establishing qualifications to perform installation functions as required in 1.9 above:
2. Statement demonstrating an understanding of project scope and schedule which includes the following information:
    a. Where (city, office) the project will be staffed.
    b. Project organizational chart with team names; e.g., project manager, A/Es, principal skilled technicians, and contractors.

C. Provide all applicable portions of the following information within 10 days of award of Subcontract:

1. Project schedule in hard copy. Include, at a minimum, major tasks, milestones, dependencies, staffing, and durations for each task.
2. Cable Contractor shall work with other contractors to merge this schedule into the overall construction schedule.
3. Provide the following information for materials, components, and equipment to be furnished by the Cable Contractor:
    a. Descriptive literature, manufacturer's specification data sheets, and manuals.
    b. Individual price and delivery schedules.
    c. Final Performance testing criteria and data for communications distribution system cabling systems.

1.10 DEFINITION OF ACCEPTANCE

A. A. System acceptance shall be defined as that point in time when the following requirements have been fulfilled:

1. All submittals and documentation have been submitted, reviewed, and approved.
2. The complete system has successfully completed all testing requirements.
3. All owner staff personnel training programs have been completed.
4. All punch list items have been corrected and accepted.
5. Project registration for warranty by manufacturer.

1.11 PROJECT RECORD DOCUMENTS

A. A. Provide detailed project record documentation within 30 days after completion of the work.

1. Maintain separate sets of red-lined record drawings for the communications work which show the exact placement and identification of as-built system components.
2. Provide communication pathway record drawings which indicate exact placement and routing for all components, e.g., maintenance holes, hand-holes, conduit, wire-way, cable tray, pull boxes, enclosures, telecommunications outlet boxes, etc.
3. Provide communication room record drawings which indicate exact placement for all components; e.g., conduit, wire-way, cable basket, cable tray, backboards, equipment cabinets, equipment racks, cross-connect equipment, etc.
4. Provide communication wiring and cabling record "As-Built'" drawings and schedules which indicate exact placement, routing, and connection details for all components, e.g., twisted-pair and fiber optic cables, splices, cable cross-connect termination locations, enclosures, telecommunications outlets, cross-connect jumpers, patch cords, etc.
5. Provide network schematics when appropriate.

PART 2 - PRODUCTS

2.1 APPROVALS AND SUBSTITUTIONS

A. The approved telecommunications hardware manufacturers:
1. Match Existing

B. If an equal product is to be bid, Cable Contractor must get prior approval from project engineer or client in order to be considered for substitution.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. Manufactured products, materials, equipment, and components shall be provided, conditioned, applied, installed, connected, and tested in accordance with the manufacturer's specifications and printed instructions.

B. The installation of all system components shall be carried out under the direction of qualified personnel. Appearance shall be considered as important as mechanical and electrical efficiency. Workmanship shall meet or exceed industry standards.

3.2 SERVICE CONTINUITY

A. Manufactured products, materials, equipment, and components shall be provided, conditioned, applied, installed, connected, and tested in accordance with the manufacturer's specifications and printed instructions.

B. The installation of all system components shall be carried out under the direction of qualified personnel. Appearance shall be considered as important as mechanical and electrical efficiency. Workmanship shall meet or exceed industry standards.

3.3 LAYOUT AND TOLERANCES

A. Follow as closely as practicable the design shown on the drawings. Make all necessary measurements in the field to verify exact locations and ensure precise location and fit of specified items in accordance with the drawings. Make no substantial alterations without prior approval of Cable Contractor and the A/E.

B. Perform all work to the lines, grades, and elevations indicated on the drawings. Provide experienced, competent personnel to locate and lay out the work and provide them with suitable tools, equipment, and other materials required to complete layout and measurement work. Use lasers or other approved methods to establish line and grade.

3.4 CONSTRUCTION REVIEW

A. The A/E and Cable Contractor will review and observe installation work to ensure compliance by the Cable Contractor with requirements of the Contract Documents.

B. The Cable Contractor shall inspect and test completed communications installations to demonstrate specified performance levels including the following:

1. Furnish all instruments and personnel required for the inspections and tests.
2. Perform tests in the presence of the A/E and Cable Contractor.
3. Demonstrate that the system components operate in accordance with the Contract Documents.
4. All existing data cabling that is to be abandoned must be removed in its entirety and discarded.
5. All unused Data cabling cabinets are to be removed and discarded.
6. All existing data boxes (TO) and wiremold raceways are to be removed and discarded.
7. All electronic equipment in the Data cabinets is to be returned to the district for reuse.

C. Review, observation, assistance, and actions by the Architect/Engineer (A/E) or General Contractor (GC) shall not be construed as undertaking supervisory control of the work or of methods and means employed by the Cable Contractor. The A/E’s and GC’s review and observation activities shall not relieve the Cable Contractor from the responsibilities of these Contract Documents.

D. The fact that the A/E, GC or the owner does not make early discovery of faulty or omitted work shall not bar the A/E, GC or the owner from subsequently rejecting this work and insisting that the Cable Contractor make the necessary corrections.

E. Regardless of when discovery and rejection are made, and regardless of when the Cable Contractor is ordered to correct such work, the Cable Contractor shall have no claim against the A/E, GC or the owner for an increase in the Subcontract price, or for any payment on account of increased cost, damage, or loss.

END OF SECTION 271000

SECTION 271100 – COMMUNICATIONS EQUIPMENT ROOM AND FITTINGS

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

B. Telecommunications Rooms (MDF/IDF) are generally considered to be floor serving facilities. Horizontal Cross-connects link the Horizontal cable and the Backbone Cable together. The Horizontal Cross-connects shall consist of rack or wall mounted wiring blocks or panels for termination of copper cables or rack or wall mount interconnect termination units or fiber management panels/trays for the termination of optical fibers. Cross-connect spaces include the labeling of hardware for providing circuit identification and patch cords or cross-connect wire used for creating circuit connections at the cross-connect.

1.2 SCOPE

A. This section includes the minimum requirements for equipment, termination hardware and cable installations in communication equipment rooms.

B. The telecommunications room shall be equipped to contain telecommunications equipment, cable terminations, and associated cross-connects.

C. Minimum composition requirements and installation methods for the following:

1. Cable Management Hardware
2. Patch Panels – Category 6

1.3 QUALITY ASSURANCE

A. All equipment rooms shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the Contract.

B. Documents shall be subject to the control and approval of the Owners representative.

C. Equipment and materials shall be of the quality and Manufacturer indicated.

D. The equipment specified is based on the acceptable manufacturers listed.

E. Where "approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified, and subject to approval.

F. Separation from sources of EMI shall be as specified in section.

G. Communication grounding/earthing and bonding shall be in accordance with applicable codes and regulations. It is recommended that the requirements of ANSI/TIA-607-E, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises throughout the entire cabling system.

H. Materials and work specified herein shall comply with the applicable requirements of:

1. ANSI/TIA-568.0-D Generic Telecommunications Cabling for Customer Premises.
2. ANSI/TIA-568.1-D Commercial Building Telecommunications Cabling Standard.
3. ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
4. ANSI/TIA-568.3-D Optical Fiber Cabling and Components Standard.
5. ANSI/TIA-569-D-1, Telecommunications Pathways and Spaces.
6. Underwriters Laboratory.
7. Federal Communications Commission (including CFR 47 and Part 68 - subpart F).
8. National Electric Code.
9. Local and State Codes.
10. ISO/IEC 11801.
11. IEC 1000-5-2.
12. CSA C22.2.
13. IEC 60603-7.

I. Manufacturers shall be ISO 9001 Certified, for all components that are required to have submittals provided as part of this section.

PART 2 – PRODUCTS

2.1 Category 6 UTP CABLE

A. Be UL VERIFIED for TIA Category 6 electrical performance.

B. Shall be UL Verified for Category 6 compliance and be CSA C22.2 approved.

C. Workstation cabling shall be blue in color.

2.2 CATEGORY 6 PATCH PANELS (IF REQUIRED)

A. Be made of a steel frame with black power coat finish 24port configurations.

B. Have mounting slots compatible with ANSI/EIA-310.

C. Allows the modular insert to accept 110-style patch plugs as a means of termination.

D. Shall be T-568B Wired.

E. Provide 24 port panels, unless otherwise noted.

F. Density must accommodate at least 24 port per single rack unit (1.75" or 44.5mm)

G. Paired punch down sequence to allow pair twist within ½" of the termination.

H. Shall have port identification numbers on front and rear of the panel.

I. Have 110 style insulation displacement contacts and termination accomplished with a single conductor impact tool or 4 or 5 pair impact tool. Optionally allow IDC style contact termination with Belden REVConnect products and tool.

J. Be backwards compatible to allow lower performing categories of cables or connecting hardware to operate to their full capacity.

K. Have circuit identification and color-coding designation strips provided with the panel.

L. Provide port configurations and densities as called for on drawings.

M. Provide rear cable management bar(s) as recommended by the Manufacturer.

N. Shall be Insulation Displacement Connector 110 style terminations.

O. Provide TIA 606-C compliant color-coded icons or color-coded designation label strips for all patch panels. Identify voice or data functionality as required.

P. Paired punch down sequence to allow pair twist within ½" of the termination.

Q. Provide rear stress relief components as recommended by the manufacturer.

R. Contractor shall first utilize all open patch panel ports. Provide a new Cat 6 24 port patch if required.

S. Acceptable Manufacturers:
1. Match existing

2.3 CATEGORY 6 PATCH CORDS - MATCH COLOR OF CABLES

A. Shall be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color- coded twisted-pairs within a flame-retardant jacket.

B. Be equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring.

C. Use modular plugs, which exceed FCC CFR 47 part 68 subpart F and IEC 60603-7 specifications, and have 50 microinches minimum of gold plating over nickel contacts.

D. Be resistant to corrosion from humidity, extreme temperatures, and airborne contaminants.

E. Utilize cable that exhibits power sum NEXT performance.

F. Be available in several colors with or without color strain relief boots providing snagless design.

G. Meet the flex test requirements of 1000 cycles with boots and 100 cycles without boots.

H. Be available in any custom length and standard lengths of meters (3, 5, 7, 10, 15, 20, and 25 feet).

1. Contractor to provide (2) patch cords per new terminated patch panel port.

2. Device end shall be 7’ in length and the patch panel end shall be 3’ in length.

I. Be made by an ISO 9001 Certified Manufacturer.

J. Electrical Specifications:

1. Input impedance without averaging 100 □ ± 15% from 1 to 250 MHz.
2. 100% transmission tested for performance up to 250MHz Manufacturer shall guarantee cords are compatible with Category 6 links.
3. Utilize cable that is UL VERIFIED (or equivalent) for TIA proposed Category 6 electrical performance.
4. UL LISTED 1863.

2.7 EQUIPMENT RACKS

A. Contractor to utilized existing wall mount rack.

B. All equipment racks shall be grounded.

PART 3 - EXECUTION

3.1 CABLE MANAGEMENT

A. Provide reusable Velcro-type hook and loop straps in each rear vertical channel. Reusable straps shall be of varying sizes (each allowing 50% spare future expansion) and of adequate quantity to secure cable bundles at least every 4 rack units.

B. Secure cable managers, slack managers, support bars, hook and loop straps per manufacturer recommendations.

3.2 CATEGORY 6 PATCH PANELS

A. Install and label as recommended by manufacturer, per all TIA 606-C.

B. Install rear cable management bar(s) as recommended by manufacturer.

C. Install TIA 606-C compliant color-coded icons or color-coded designation label strips for all patch panels. Identify Data functionality.

3.3 CABLE SUPPORTS

A. Keep horizontal wall mounted cable runs to a minimum. In general horizontal runs shall be on wall mounted ladder rack.

B. Provide cable brackets 3’ on center supported to building structure for all cable runs not supported by cable tray.

3.4 MISCELLANEOUS REQUIREMENTS

A. All cables shall be neatly “dressed out” in equipment rooms.

B. Provide service loops on all cables terminated in the telecommunications rooms, per the drawings.

C. Firestop all sleeves and conduits openings after the cable installation is complete.

END OF SECTION 271100

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SECTION 271500 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Horizontal (distribution) communications wiring and connecting hardware from the Telecommunications Room (IDF) to Telecommunication Outlets (TO) throughout the site.

1.2 REFERENCES

A. All work shall be performed in accordance with the following codes and industry standards, unless noted otherwise:

1. NFPA 70 - National Electrical Code, current version adopted by local or State AHJ.
2. ANSI/TIA-568.0-D Generic Telecommunications Cabling for Customer Premises
3. ANSI/TIA-568.1-D Commercial Building Telecommunications Cabling Standard
4. ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards
5. ANSI/TIA-569-D-1, Telecommunications Pathways and Spaces.
6. ANSI/TIA-526-14-C, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
7. ANSI/TIA-606-C, Administration Standard for Commercial Telecommunications Infrastructure.
8. ANSI/TIA-607-E, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
9. ANSI/TIA-1152–2009, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
10. ANSI/TIA TSB-162-A Telecommunications Cabling Guidelines for Wireless Access Points
11. IEEE 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to communication systems

1.3 SYSTEM DESCRIPTION

A. The horizontal distribution subsystem refers to all intra-building twisted-pair and fiber optic (if required) communications cabling connecting Main Distribution Frames (MDF) and/or Intermediate Distribution Frames (IDF's) to telecommunication outlets (TO's) located at individual work areas.

B. Horizontal cabling may consist of a combination of the following types of cable from the MDF/IDF to the TO:

1. Data Cables: Category 6, (250MHz, 4-pair, ANEXT, unshielded twisted pair), for cables from the MDF/IDF's to the TO's.

C. The Horizontal System includes cables, jacks, connectors, patch panels, connecting blocks, patch cords, fiber connectors and jumpers as well as the necessary support systems, such as cable managers and faceplates.

D. Cables may be routed through conduit, cable trays, spaces below raised floors, open ceiling areas, non-ventilated spaces above ceiling tile, and through plenum air-handling spaces above ceiling tile.

E. Cable Contractor shall furnish and install all materials necessary for a complete and working system.

F. All cables shall be plenum rated.

1.4 WARRANTY

A. The Cable Contractor must be an approved manufacturer's Certified Contractor. The Cable Contractor is responsible for workmanship and industry standard installation practices. The certified contractor shall have 30% of their technicians trained on copper & fiber installations and testing by the manufacture; they also shall have at least 1 project manager.

B. Cable Contractor shall provide labor, materials and documentation according to manufactures requirements necessary to ensure that the Owner will be furnished with a Warranty of 25 years in length.

C. The copper warranty guarantees installed static channel (Includes patch cords) performance above the TIA Standards for CAT 6 cabling systems. The static channel performance tests shall be performed in the field with an approved Cable certification tester in the channel test configuration.

D. Horizontal channel solution is to conform to all requirements of Category 6 performance.

E. All necessary documentation for warranty registration must be provided to manufacturers will be furnished by the Cable Contractor immediately following 100% testing of all cables. All test results shall be submitted to manufactures in the certification tester's original software on CD.

F. Cable Contractor shall administer the warranty process with the responsible manufacturer's representative. The warranty shall be provided directly to the owner from the manufacturer. Cable Contractor shall insure that the manufacturer provides the Owner with the appropriate warranty certification within 30 calendar days of the final project completion.

PART 2 - PRODUCTS

2.1 APPROVALS AND SUBSTITUTIONS

A. All products shall be provided as specified without exception, unless approved in writing prior to the bid.

B. Non-compliant products installed as a part of this Contract shall be removed and replaced and all costs for removal and replacement shall be borne solely by the Cable Contractor(s).

C. All products shall be "NEW".

2.2 STATION CABLING

A. 250 MHZ, Category 6, 4-pair unshielded twisted pair, CMP rated

1. Manufacturer
   a. General Cable
2. Data cable jacket color shall be blue for station cables.
3. Contractor to field coordinate exact cable color with architect and GC prior to installation.

2.3 MODULAR JACKS

A. Category 6 modular jacks modular jacks

1. 8-position modular jack, Category 6, IDC terminals, T568B wiring scheme
2. Each jack must be stamped or have icons to identify it as CAT 6.
3. Color to be coordinated with building finishes and Architect.
4. Manufacturers:
   a. Match existing

2.4 WORK AREA OUTLETS

A. Flush mounted faceplates

1. Single gang face plates constructed from fire retardant plastic with label fields, mounts within a double gang wall box with reducer plate.
   a. Existing Manufacturer
      1) Single gang 1 port
      2) Single gang 2 port
      3) Single gang 4 port
      4) Wall Phone Plate
      5) All unused plate opening are to be provided with a blanking insert - color shall match that of the plate.
         a) All faceplate colors are to be coordinated with owner and architect to match finish.

2.5 PATCH PANELS

A. Category 6 Patch Panels

1. Cat 6 110-StylePatch Panel, 24-Port, 1RU.

PART 3 - EXECUTION

3.1 GENERAL

A. Horizontal cabling includes cables, jacks, patch panels, connecting blocks, and patch cords, as well as the necessary support systems, such as cable managers and faceplates.

B. Cable Contractor shall furnish and install all materials necessary for a complete and working system.

C. Cable Contractor must be a Certified Systems Vendor for the cable system bid and installed - up to, during, and through completion of the system installation, and must be able to provide the manufacturer’s extended warranty.

D. Field terminated copper and fiber optic patch cords and jumpers are not allowed.

E. All work shall be performed in a professional manner.

F. Install cable after interior of building has been physically protected from the weather and all mechanical work likely to damage cabling has been completed.

G. Before installing cabling, ensure all cable pathways are completely and thoroughly cleaned:

H. Inspect conduit, wire-way, cable trays and innerduct installed by others.

I. Clean any additional enclosed raceway and innerduct systems furnished.

J. Provide protection for exposed cables where subject to damage.

K. Provide abrasion protection for any cable or wire bundles, which pass through holes or across edges of sheet metal. Protective bushings shall be used to protect cables.

L. Velcro type Cable ties and other cable management clamps shall be no more than hand tightened and shall fit snugly, but not compress, crimp, or otherwise change the physical characteristics of the cable jacket or distort the placement of twisted-pair components. Replace any cable exhibiting stresses due to over tightening of cable management devices. Plenum spaces require Plenum rated cable ties. Plastic cable ties are not allowed.

M. Where possible, route cables in overhead cable trays and inside wire management systems attached to the equipment cabinets and racks. Do Not Use plastic ties or ducts to restrain cabling installed outside of wire management systems on racks or in cabinets. Cable trays shall not exceed 50% fill.

N. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

O. Cable raceways shall not be filled greater than the ANSI/TIA-569-D-1, Telecommunications Pathways and Spaces-A maximum fill for the particular raceway type.

P. A cable basket system shall be used to support cable bundles through-out the building. All cable basket shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable basket rest on acoustic ceiling grids, plumbing pipes, and electrical conduits.

Q. Horizontal distribution cables shall be bundled in groups of no more than the amount of cables designed for by the cable basket manufacturer recommends based on cable OD and weight. The cable basket system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

R. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Cable Contractor shall install appropriate carriers to support the cabling.

S. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Cable Contractor prior to final acceptance at no cost to the Owner.

T. Telecom integrator to coordinate final location of all devices with client.

3.2 UNSHIELDED TWISTED PAIR CABLE INSTALLATION PRACTICES

A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

B. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.

C. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

D. The cable's minimum bend radius and maximum pulling tension shall not be exceeded Bend radius for as outlined in ANSI/TIA.

E. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.

F. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.

G. Separation from Power Lines: Provide the following minimum separation distances between pathways for copper communications cables and power wiring of 480 volts or less:

1. Open or Nonmetal Communications Pathways:
    a. 12 inches from electric motors, fluorescent light fixtures, and unshielded power lines carrying up to 3 kVA.
    b. 36 inches from electrical equipment and unshielded power lines carrying more than 5 kVA.
    c. 48 inches from large electrical motors or transformers.

2. Grounded Metal Conduit Communications Pathways:
    a. 2 1/2 inches from electrical equipment and unshielded power lines carrying up to 2 kVA.
    b. 6 inches from electrical equipment and unshielded power lines carrying from 2 kVA to 5 kVA.
    c. 12 inches from electrical equipment and unshielded power lines carrying more than 5 kVA.
    d. 3 inches from power lines enclosed in a grounded metal conduit (or equivalent shielding) carrying from 2 kVA to 5 kVA.
    e. 6 inches from power lines enclosed in a grounded metal conduit (or equivalent shielding) carrying more than 5 kVA.

3.3 UNSHIELDED TWISTED PAIR TERMINATION

A. Cables shall be coiled to house the cable coil without exceeding the manufacturers bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12" of UTP and 36" of fiber slack shall be stored; Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

B. Cables shall be dressed and terminated in accordance with the recommendations made in the latest version of ANSI/TIA -568-D document, manufacturer's recommendations and best industry practices.

C. All 4 pair cables shall be terminated on the jack and patch panels using T568-B wiring scheme - CONFIRM FINAL TERMINATION CONFIGURATION WITH DESIGN ENGINEER OR CLIENT PRIOR TO BEGINNING TERMINATIONS

D. Pair untwist at the termination shall not exceed 12 mm (one-half inch).

E. Bend radius of the horizontal cable shall not be less than 4 times the outside diameter of the UTP cable. 8 times for FTP cables.

F. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.

G. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).

H. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

I. The cable jacket shall be maintained as close as possible to the termination point. Cable shall not have more than 1.0” removed.

3.4 TESTING PROCEDURES

A. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the latest requirements of ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

B. All cables shall be tested in accordance with this document, the ANSI/TIA standards, and best industry practice. If any of these are in conflict, the Cable Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

C. Cables, jacks, connecting blocks, and patch panels shall be in there final position with the building energized.

D. All Unshielded Twisted Pair cables shall be tested as follows:

1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using an approved certification tester (Fluke or Equal) for Category 6 performance compliance as specified in ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards
2. Follow the Standards requirements established in ANSI/TIA-568-C.2.
3. Testing shall be accomplished with an approved certification tester (Fluke is preferred)

4. The basic tests required are:
   a. Wire Map
   b. Length (feet)
   c. Insertion Loss (dB) (Formerly Attenuation)
   d. NEXT (Near end crosstalk) (dB)
   e. Return Loss (dB)
   f. ELFEXT (dB)
   g. Propagation Delay (ns)
   h. Delay skew (ns)
   i. PSNEXT (Power sum near-end crosstalk loss) (dB)
   j. PSELFEXT (Power sum equal level far-end crosstalk loss) (dB)
   k. Note: CAT 6a cable shall be tested to a CAT 6a auto test to 500 MHz.
5. All test results shall be provided in the approved certification testers original software format on a CD, with the following minimum information per cable:
   a. Circuit ID
   b. All information from 3.4D.4 above.
   c. Test result, “Pass” or “Fail”
   d. Date and Time of test
   e. Project Name
   f. NVP
   g. Version of software
   h. Note: No asterisk * will be accepted by client. These results shall be retested and submitted after a PASS is received.
6. A software copy of the test results, in the original tester software format, shall be provided to the Owner and Belden.
7. Cable Contractor shall provide a fully functional version of the tester software for use by the Owner in reviewing the test results.
8. Any failed test results that cannot be remedied through re-termination (as in the case of reversed or split pairs), must be reported in writing to the Owner immediately, along with a copy of the test results.

3.5 LABELING

1. All horizontal cables are to be labeled using a machine printed label at each end of the cable at approximately 12 inches of the termination point, and again at approximately 48 inches from the termination point. Handwritten labels shall not be used.

B. All patch panel ports and TO ports shall be labeled with the cable identifier.

C. The labels shall denote the TO ID, as well as the unique cable number for that TO, i.e. A-001-A for cable number 1, A-001-B for cable number 2, and so forth. Owner may provide specific labeling requirements coordinate with owner.

D. Note all labeling information on the as-built drawings.

END OF SECTION 271500

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SECTION 271600 – COMMUNICATIONS CONNECTING CORDS, DEVICES AND ADAPTERS

PART – GENERAL

1.1 REFERENCES

A. All work shall be performed in accordance with the following codes and industry standards, unless noted otherwise:

1. NFPA 70 - National Electrical Code, current version adopted by local or State AHJ.
2. ANSI/TIA-568.1-D Commercial Building Telecommunications Cabling Standard
3. ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards
4. ANSI/TIA-568.3-D Optical Fiber Cabling and Components Standard
5. ANSI/TIA-569-D, Telecommunications Pathways and Spaces. Including Addendum 1.
6. ANSI/TIA-606-C, Administration Standard for Commercial Telecommunications Infrastructure.
7. ANSI/TIA-607-E, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
8. IEEE 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to communication systems.

1.2 WARRANTY

A. The Cable Contractor must be an approved Manufactures Certified Contractor. The Cable Contractor is responsible for workmanship and installation practices in accordance with the Manufactures Certified Installer Program. The certified contractor shall have 30% of their technicians trained on copper & fiber installations termination and testing of products used in this installation. Manufacturer will extend a 25-year Warranty to the end user.

B. The copper warranty guarantees installed static channel (includes patch cords) performance above the TIA Standards for Cat 6 cabling systems. The static channel performance tests shall be performed in the field with an approved Manufactures Certification tester in the channel test configuration.

C. Cable Contractor shall provide labor, materials and documentation according to Manufactures requirements necessary to ensure that the Owner will be furnished with a warranty covering product and applications for a maximum of 25 years in length.

D. All necessary documentation that must be provided to the manufacturer will be furnished by the Cable Contractor immediately following 100% testing of all cables.

E. Cable Contractor shall administer the warranty process with the responsible manufacturer's representative. The warranty shall be provided directly to the owner from the manufacturer. Cable Contractor shall insure that the manufacturer provides the Owner with the appropriate warranty certification within 90 calendar days of the final project completion.

PART 2 - PRODUCTS

2.1 APPROVALS AND SUBSTITUTIONS

A. All products shall be provided as specified, without exception, unless approved in writing prior to the bid. All products shall be "NEW".

B. Non-compliant products installed as a part of this Contract shall be removed and replaced and all costs for removal and replacement shall be borne solely by the Cable Contractor(s).

2.2 PATCH CORDS/JUMPERS

A. Category 6 unshielded twisted pair.

a. Plenum rated patch cord for outlets within the ceilings.

B. Factory terminated double ended, 8-position to 8-position, modular, stranded conductors, Category 6 4 pair.

1. 7' Cat.6 Patch Cord (device end).
2. 3' Cat. 6 Patch Cord (patch panel end).
3. Provide (2) Cat 6 patch cords per new terminated patch panel port.
4. Contractor to field coordinate exact patch cord lengths and colors with Owner and GC prior to purchasing.

PART 3 - EXECUTION

3.1 GENERAL

A. Category 6 modular patch cords

B. Factory terminated double ended, 8-position to 8-position, modular, stranded conductors, Category 6 4 pair.

C. One 7-foot long Category 6 (device) & (1) 3-foot long Category 6 patch cords (patch panel) as noted below be supplied for each work station (faceplate) installed as part of this project. Stations include:
1. Voice and data stations
2. Wireless access points
3. A/V network stations

1. Cable Contractor shall patch all terminated stations from patch panel to network switch in MDF & IDF's.

D. Cable ties and other cable management clamps shall be no more than hand tightened and shall fit snugly, but not compress, crimp, or otherwise change the physical characteristics of the cable

jacket or distort the placement of twisted-pair components. Replace any cable exhibiting stresses due to over tightening of cable management devices.

E. Where possible, route cables in overhead cable trays and inside wire management systems attached to the equipment cabinets and racks. Use plastic ties or ducts to restrain cabling installed outside of wire management systems on racks or in cabinets.

F. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Cable Contractor shall install appropriate carriers to support the cabling.

G. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Cable Contractor prior to final acceptance at no cost to the Owner.

3.2 LABELING

A. All patch cords are to be uniquely labeled at each end at approximately 2 inches from the termination point.

B. Note all labeling information on the as-built drawings.

END OF SECTION 271600

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SECTION 274116 - INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. The work of this Section is governed by the General Conditions, Supplementary Conditions and Sections in Division 1 Project Manual.

B. The audio-visual system has been designated as a "Proprietary Product" to match and integrate with the existing systems.

C. Perform work and provide materials and equipment as shown on Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide complete and fully functional systems installation.

D. Give notices, file plans, obtain permits and licenses, pay fees and backcharges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with the Contract Documents.

E. The work under this Section includes providing of all material, labor, equipment and supplies and the performance of all operations to provide a complete working system as required by the Drawings and details and as specified herein. Where the Drawings, Specifications, Codes, Regulations, Laws, or the requirements of the local Authority conflict, provide the higher quality and higher quantity indicated or required and follow the most strict requirement. In general, the work includes, but is not limited to, the following:

1. Equipment Racks and Cabinets.

2. Terminations.

3. Audio/Visual Cabling:

4. Telecommunications Cabling

5. Audio/Visual Electronic System Components

6. Pathways and Supports

7. Protection of new and existing work.

8. Record Drawings and Documentation.

9. Testing and certification.

10. Coordination with manufacturers, other trades, General Contractor and Owner. Include costs associated with adjustments and changes resulting from coordination.

11. Costs associated with core drilling and cutting and patching using appropriate and trained tradesmen approved by the General Contractor and the Architect.

1.2 REFERENCES

A. All work, equipment, and systems shall be manufactured, provided, repaired, installed, and tested in accordance with the latest edition and all current amendments of the applicable publications and standards of the organizations listed below as of the date of the Contract Documents.

1. Massachusetts Building Code

2. National Fire Protection Association, 1994 (NFPA 70)

3. National Fire Protection Association Life Safety Code, 1994 (NFPA 101)

4. Building Officials & Code Administrators International, Inc. (BOCA) National Building Code

5. Americans with Disabilities Act (ADA)

6. Underwriters Laboratories (UL) Applicable Standards for Safety

7. Underwriters Laboratories (UL) Applicable Standards for Proprietary Security Systems

8. Uniform Building Code, 1994 (UBC)

9. Open network video interface forum (ONVIF) standards and compliance

10. International Building Code (IBC), 2015

11. ANSI/INFOCOMM V202.01:2016 Display image Size for 2D Content in Audiovisual Systems

12. ANSI/INFOCOMM F501.01:2015 Cable Labeling for Audiovisual Systems

13. ANSI/INFOCOMM A102.01:2017 Audio Coverage Uniformity in Listener Areas

14. ANSI/INFOCOMM 2M-2010, Standard Guide for Audiovisual Systems Design and Coordination Processes

15. ANSI/INFOCOMM 3M-2011, Projected Image System Contrast Ratio

16. ANSI/INFOCOMM 4:2012 Audiovisual Systems Energy Management

17. ANSI/INFOCOMM:2013, AV Systems Performance Verification

1.3 QUALITY ASSURANCE

A. Qualifications: Use adequate numbers of skilled, experienced workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

1. The Installer (Firm and Employees) shall be experienced in the operations they are engaged to perform. Demonstrate at least five years of continuous recent experience on similar projects. The Installer shall hold recent, up-to-date licenses, certifications and training certificates in the area the project is located and for the equipment to be installed.

2. Provide names of contacts from the last five similar projects including the General Contractor, Owner's Representative, Architect and Engineer. Indicate project locations, scope and current phone numbers that the contacts can be reached at.

3. Qualified integration Installation firms shall have demonstrable design and installation training with certifications of competence

4. Provide a full time on site foreman who personally has been certified as described above. Submit all documentation under this Section.

5. The contractor must maintain at a minimum of one Infocomm CTS-I, and one CTS for the project.

6. Provide a Project Manager to supervise the project.

7. Each Foreman and Installer working on this project shall be trained to the qualified level as specified by the manufacturer(s) for installation and maintenance of equipment and of the structured cable system being provided on this project, such that the product manufacturer’s extended warranty will be in full force.

a. The training shall consist of a minimum of proper installation techniques of their specific equipment in order to have a complete operating system meeting or exceeding the requirements as specified herein.

b. Each Foreman and Installer working on this project shall have documentation from the manufacturer indicating that he or she has been adequately trained prior to the start of the project. Only Foremen and Installers who have been properly certified and documented by the manufacturer whose equipment is being provided on this project shall be allowed to install the same.

8. Maintain at the site an updated copy of the Manufacturer Trained Installers list including a copy of their training documentation from the manufacturer. This documentation shall be made available to the Architect upon request.

B. Substitutions: Comply with pertinent Sections of Division 1 and Section 20 05 00 - Basic Mechanical and Electrical Requirements.

C. NRTL Compliance. Comply with requirements of UL-50. The communication system supplies shall be listed by Underwriters' Laboratory under UL® Standard 1459. A copy of the proposed card for the proposed system shall be included with the Contractor's submittal.

1.4 SYSTEMS DESCRIPTION

A. Audio/Visual System Description:

1. Provide:

a. A complete audio and visual system for each Room and Common Area as described on the drawings

2. The intent of this project is to provide complete A/V connectivity and equipment for each area. The drawings indicate specific manufacturers for equipment. Contractors cannot substitute manufacturers unless acceptable by the owner. Provide equipment matrix of all components with the bid response.

3. Coordinate what has been provided and what else may be required in order to provide complete installed operating audio visual systems. Provide components, supports and pathways NOT being provided under other Sections, but required for a complete system.

B. Room Equipment:

1. Multipurpose Room 124**:**

a. The room shall be a divided multipurpose room
b. Each room shall be controlled by a 10" touch panel at the front of the room
c. There shall be a single gang digital media faceplate at the front of the room.
d. For each room, there shall be a Da-Lite Advantage 159.5" diagonal 16:9 electric screen with low voltage control at the front of the room.
e. For each room, there shall be a Epson Powerlite L210W projector with ceiling mount and standard throw lens for the room.
f. There shall be (9) nine Crestron IC6T-W-T ceiling speakers per side. There will be a Shure wireless microphone system for each room with remote antenna mounted on the wall at the rear of each room. For each room, there shall be (1) lapel microphone with body pack, (1) handheld microphone, (1) boundary microphone, and (1) charging station for both body packs and microphones.

2. Headend Room in AV Closet 124C:

   a. The storage within the multipurpose room shall have the Audio-Visual headend cabinet.
   b. There shall be a 12RU, extra deep wall mount rack in the closet
   c. The cabinet shall house the AV digital presentation switcher, network switches, and wireless microphone receiver
   d. The cabinet shall also have a Crestron TSW1060-NC with rack mount kit for local programming.

3. Zoom Rooms**:**

   a. There shall be a single gang HDMI and USB pass through faceplate at the front of the room.
   b. There shall be a 32" 4K flat panel display in the space
   c. There shall be a Chief PAC BOX behind the displays in each room
   d. There shall be a Jabra Panacast 50 integrated soundbar, microphone and camera below the display in with wall adapter.
   e. There shall be (1) wireless dongle (Anycast or approved equal)

4. Lounge/Meeting Room 113**:**

   a. There shall be a single gang HDMI and USB pass through faceplate at the front of the room.
   b. There shall be a wall controller for the display (on/off, volume, source selection)
   c. There shall be a 75" 4K flat panel display in the room
   d. There shall be a Chief PAC BOX behind the displays in the room
   e. There shall be a Jabra Panacast 50 integrated soundbar, microphone and camera below the display in with wall adapter.
   f. There shall be (1) wireless dongle (Anycast or approved equal).

5. Computer Room 106**:**

   a. There shall be a single gang HDMI and USB pass through faceplate at the front of the room.
   b. There shall be a wall controller for the display (on/off, volume, source selection)
   c. There shall be a 75" 4K flat panel display in the room
   d. There shall be a Chief PAC BOX behind the displays in the room
   e. There shall be a Jabra Panacast 50 integrated soundbar, microphone and camera below the display in with wall adapter.
   There shall be (1) wireless dongle (Anycast or approved equal

6. Provide (5) five wireless dongles for deployment throughout the facility. Wireless dongle shall be Anycast or approved equal.

7. The intent of this project is to provide complete A/V connectivity and equipment for each area. The drawings indicate specific manufacturers for equipment. Contractors cannot substitute manufacturers unless acceptable by the owner. Provide equipment matrix of all components with the bid response.

8. Coordinate what has been provided and what else may be required in order to provide complete installed operating audio visual systems. Provide components, supports and pathways NOT being provided under other Sections, but required for a complete system.

1.5 SUBMITTALS

A. Comply with the pertinent provision of Sections in Division 1 and Section 20 05 00 Basic Mechanical and Electrical Requirements.

B. Qualifications: Submit qualifications as specified in this Section under Quality Assurance.

C. Organization of Shop Drawings: Submit shop drawings and product data submittals in bound packages organized and titled to match the Articles of Part 2 as specified in this Section.

D. Indicate clearly all equipment, components or assemblies that are not NRTL listed or labeled. Failure to indicate otherwise implies NRTL listing or labeling. Products found not to be NRTL listed or labeled where such listing or labeling is available shall be replaced.

E. Include in Submittals:

1. Application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.

2. Instructions for storage, handling, protection, examination, preparation, operation and installation of product.

3. Detailed shop drawings that show system flow diagrams for each space, detailed installation diagrams, and detailed system risers when applicable.

F. Maintain at the job site the latest equipment submittals showing the action taken by the Architect. Make these submittals available to Architect.

G. Product Data: Submit catalog data sheets or other published materials showing appearances, electrical ratings characteristics and connection requirements, seismic ratings, performance characteristics, dimensions, weights, installation methods, and space requirements of equipment and their accessories, as listed below and as required elsewhere in the Specifications and as requested by the Architect. Highlight the specific part numbers as intend to use:

1. Identification Methods
2. Cable pathways
3. Wire and Cable
4. Wiring Devices
5. Grounding and Bonding
6. Seismic Supports and Supplementary Steel
7. Seals and Fittings
8. All equipment and devices as noted under "Work Included"
9. Test Report Formats

10. Test Equipment
11. Test Procedures

H. Shop Drawings: Submit shop drawings indicating physical size and arrangement, (plans and elevations) construction details, provisions for conduits, access requirements for installation and maintenance, Seismic, finishes, and materials used in fabrication. Supplement shop drawings with wiring diagrams and information as described under Product Data. Provide Shop Drawings for the following and as required elsewhere in the Specifications and as requested by the Architect:

1. Audio Systems

2. Visual Systems

3. Submit complete shop drawings showing inventory of equipment to be installed, parts, and quantity for each communications equipment room and wiring room. Include configuration of complete installed system.

4. Design Data: Submit completed cable schedules for each cable including horizontal and backbone cables, based on construction room numbering.

I. Samples:

1. Submit three samples of each connector and termination.

2. Submit 5'-0" sample of all cables to be installed on this project including associated published cabling specification and Note Nominal Velocity of Propagation (NOMINAL VELOCITY OF PROPAGATION (NVP)).

J. Test and Repair Documentation: Provide sample system test records and repair records consisting of the following:

K. Submit certified test report on each piece of the A/V field testing equipment to be used on this project. Certified test report shall include at least the factory calibration date and test results. Factory calibration and testing shall take place immediately before actual systems testing is to take place. Factory calibration and testing date deemed too far in advance of actual testing may be rejected.

1. As a minimum the submittal shall include the following:

a. Description of the configuration and operation of the proposed system.

b. Outline drawings of all proposed equipment in plan and elevation views including overall dimensions, weights and clearances required.

c. A complete copy of the specifications with each sub-paragraph on each page noted in the right hand margin with the comment, "compliance", "deviation", or "alternate". In the case of non-primary, vendor-supplied items, the name of the sub-vendor supplying said item, including model number shall be indicated.

1) By noting the term "compliance", it shall be understood that the Manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.

2) By noting the term "deviation", it shall be understood that the Manufacturer prefers to provide a different component in lieu of that specified. Manufacturer shall indicate all deviations and indicate what is being proposed.

3) By noting the term "alternate", it shall be understood that the Manufacturer proposes to provide the same operating function but prefers to do it in a different manner. An alternate shall be fully described as to what the manufacturer proposes to provide.

L. Record Drawings: Submit record drawings in accordance with the pertinent provisions of Division 1 for Project Record Documents and Section 20 0500 - Basic Mechanical and Electrical Requirements.

M. Operation and Maintenance Manuals: Submit copies of the Operation and Maintenance Manuals in compliance with the requirements of Division 1 as specified for Contract Close-Out requirements, Section 20 0500 - Basic Mechanical and Electrical Requirements, and the additional requirements of this Section.

N. Submittal Schedule: Prepare and submit shop drawings, O & M manuals and perform training as indicated on the following schedule:

1.6 WARRANTY

A. Manufacturers shall provide replacement warranties for material and equipment furnished under this Section. Such warranties shall be in addition to and not in lieu of all liabilities, which the Manufacturer and the Installer may have by law or by provisions of the Contract Documents.

B. All materials, equipment and work furnished or installed under this Section shall be warranted against all defects in materials and workmanship for a period of one year, or for the manufacturer(s)' extended warranty period, whichever is longer, commencing with the date of Substantial Completion. Any failure due to defective material, equipment, installation or workmanship which may develop shall be corrected at no expense to the Owner including all materials, labor, travel, expenses, system diagnostics and damage to areas, materials and other systems resulting from such failures.

C. Upon receipt of notice from the Owner of failure of any part of the systems during the warranty period, the affected parts shall be replaced. Any equipment requiring excessive service consisting of more than two unscheduled service calls shall be considered defective and shall be replaced.

D. Where warranties, maintenance contracts, or training are required beyond a period of one year, provide written proof from the manufacturer for the time period indicated and acceptable to the Architect and provide a performance bond payable to the Owner covering the required work for the time period. Written proof and bonds shall be submitted prior to payment for Substantial Completion.

E. Include copies of all warranties, maintenance contracts, training contracts and performance bonds in the Operation and Maintenance Manuals.

F. Extended Product Warranty

1. The Extended Product Warranty covers product defects for all passive components (i.e.: cabling and terminating equipment). Passive components are defined as those exhibiting no gain or contributing no energy. The manufacturer(s) for installation and maintenance of equipment of the structured cable system being provided on this project warrants, from the date of Substantial Completion, the following:

    a. That the passive products that comprise the A/V cabling system solution will be free from manufacturing defects in material or workmanship under normal and proper use;

2. Under the Extended Product Warranty, the product manufacturer(s) will either repair or replace the defective product itself at the manufacturer(s)' cost, or the manufacturer(s) will pay a qualified integration installation firm with certifications from the manufacturer(s) for the cost of labor to repair or replace any such defective product on behalf the manufacturer(s).

G. Response times to warranty issues shall differ according to the level of the problem.

1. A problem is considered to be corrected when the system and its components operate according to specified requirements.

2. Warranty work must be performed according to the procedures of the Owner, its staff and users and their normal operations.

3. The following levels of response to problems are required:

    a. Major Failure: 4 hour maximum response time if notified by telephone, 24 hours per day, 365 days per year.

    b. Minor Failure: 24 hours maximum response time if notified by telephone, 365 days per year.

4. Failures are defined as follows:

    a. Major Failure: a system failure, which disables the entire system or major part of the system or an individual critical piece of equipment, which prevents the proper operation of more than one system component.

    b. Minor Failure: a system failure which affects only one non-critical component and does not affect operation of any other components or any failure which is not defined as a major failure.

c. Major and minor failures are as defined by the Owner.

5. Response time to a call is defined as the time at which a qualified technician arrives at the site and starts repairs or diagnostics. If the problem has not been corrected within two hours of the initial response, regional and/or national support personnel shall be contacted for assistance.

H. Adequate stocks of parts, components, etc. and access to regional and national support personnel shall be available such that all major failures shall be corrected within 8 hours of Owner's initial telephone call and all minor failures within 48 hours. Temporary components may be used to meet this requirement while new components or repairs are completed. Temporary components shall be replaced with new (unused) components or the repaired original component as soon as practical. Remanufactured equipment or components are not considered new and shall not be used.

I. Provide certified factory trained technical service personnel for service and maintenance of the system.

J. Provide a copy of this warranty section in the Operations and Maintenance Manuals. Each copy shall be dated, signed and certified by an authorized Representative of the Installer providing work under this Section stating that these requirements are understood and will be complied with without exception.

K. Provide extended warranty as indicated in this specification.

1.7 CERTIFICATES OF APPROVAL

A. Upon completion of all work, and as a condition to receiving payment at Substantial Completion, furnish to the Architect the following original signed certificates and include copies of these certificates as part of the Operation and Maintenance manuals:

1. Certification from the manufacturers authorized representative stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be installed in accordance with the manufacturer's requirements, all requirements for manufacturer's warranties are complied with, and equipment is in satisfactory operating condition. This certification shall be provided for each piece of major equipment and cabling and for all complete systems. Provide certificate for additional items requested by the Architect.

2. Certificates of inspection, letters or notices from the appropriate governmental authorized inspectional authorities stating that all portions of the work (indicate trade and responsibility) have been inspected and are installed in conformance with the applicable codes, laws, ordinances and referenced standards. If non-conformance notices are received, include the re-inspection certificate, letter of explanation, etc. as required to indicate complete conformance. Provide written evidence of all exceptions or variances given by any Inspector.

3. Certificate from the installing firm responsible for the work (indicate trade and responsibility) signed by an authorized Officer of the firm and the Foreman or Project Manager in charge, indicating trade license numbers and stating that to the

best of the signer's knowledge and belief that the project (indicate project name and address) has been installed in compliance with the Contract Drawings, Specifications and Addenda, and all applicable codes, laws, ordinances and referenced standards. Where sub-contractors perform a portion of the work of this section include certificates from them.

B. Final affidavit for the occupancy permit will not be signed until the above certificates have been submitted and accepted.

1.8 SUBSTANTIAL COMPLETION

A. When Work under this Section, or a designated portion of Work, is substantially complete, submit written notice through the Construction Manager with a list of items remaining to be completed or corrected.

B. Should Architect observe and find Work is not substantially complete, promptly notify the Construction Manager, in writing, listing observed deficiencies.

C. Remedy all deficiencies and submit a second written notice of Substantial Completion.

D. Substantial Completion shall not be considered unless work remaining is less than one percent of the Contract Value of this Section and all systems are operational and tested to verify compliance with Contract Documents. Only minor items shall remain to be completed.

E. Record Drawings, Operation and Maintenance Manuals, Acceptance Demonstrations, Owner personnel training, spare parts or extra materials required, test reports, warranties, performance bond for extended warranties and maintenance contract and training, and certifications of installation inspections shall be submitted and accepted prior to Substantial Completion.

F. When Architect finds Work is substantially complete, a Certificate of Substantial Completion in accordance with provisions of the Contract Documents will be prepared.

G. Certificate of Substantial Completion will not be issued without receipt of all test reports and certificates of warranty.

1.9 FINAL COMPLETION

A. When Work under this Section is complete, submit through the Construction Manager written certification that:

1. Contract Documents (which include addenda, clarifications, requests for information (RFIs), change orders and instructions from the Architect) have been reviewed.

2. Work has been inspected for compliance with Contract Documents.

3. Work has been completed in accordance with Contract Documents and deficiencies listed with Certificate of Substantial Completion have been corrected.

4. Equipment and systems have been tested, adjusted and balanced and are fully operational.

5. Work is complete and ready for Architect's final review.

B. Should Architect observe and find Work incomplete, the review will be promptly suspended and the Construction Manager notified in writing.

C. Complete work, remedy deficiencies and send a second certification of Final Completion.

D. Architect, upon receipt of a second certification of completion, shall make a second review and shall notify the Construction Manager listing observed deficiencies.

E. When Architect finds Work is complete, he will consider close out submittals.

F. Final payment of up to 10 percent of Contract Value (in addition to any retainage being withheld) will be withheld until all punch list items, close out submittals, certifications, training performance bonds, and Acceptance Demonstrations are provided and accepted.

1.10 OPERATING INSTRUCTIONS AND OPERATION AND MAINTENANCE (O&M) MANUALS

A. Give detailed instructions, prior to the Substantial Completion of the work, to the responsible personnel designated by the Owner in the operation and maintenance of all work installed under this Section. A letter with two copies containing the name of the person or persons to whom the instructions were given and the dates of the instruction period shall be submitted to the Architect at the completion of the project.

B. Prepare three sets of Operation and Maintenance (O& M) Manuals containing Manufacturer's catalogs, other similar data including the necessary photographic equipment cuts, wiring diagrams and final reviewed Shop Drawings and Product Data covering all equipment and devices furnished or installed under this Section. These manuals shall provide complete instructions for the proper operation and use of the equipment together with instructions for lubrication and periodic maintenance and for trouble shooting. Operating instructions shall be specific for each system and shall include copies of posted specific instructions. This manual shall contain only that information which specifically applies to this project and all unrelated material shall be deleted or clearly crossed out.

C. As a minimum training sessions shall consist of the following:

1. General project information and review shall be by the General Foreman or Superintendent of the Trade.

2. Specific system training shall be by a Factory Trained Representative.

3. Provide a complete review of the project and systems including, but not limited to, the following:

a. Note equipment layouts, locations and control points.

b. Review each system.

c. Review system design operation and philosophy.

d. Review areas served by equipment.

e. Identify color codes used.

f. Review features and special functions.

g. Review maintenance requirements.

h. Review operation and maintenance manuals.

i. Respond to questions

4. After classroom training, walk the entire project, review each equipment room and typical locations. Explain equipment and proper operation.

D. During the instruction period, the Operation and Maintenance Manual shall be used and explained.

E. The Operation and Maintenance Manual material shall be bound in 3-ring binders and indexed. On the edge of the binder, provide a clear see-through plastic holder with a typed card indicating the Project name, the Engineer's name, the Installer's name and the Volume number (e.g., Vol. No. 1 of 2).

F. Provide name, address and telephone number of the manufacturer's representative and service company for all items supplied so that the source of replacement parts and service can be readily obtained.

G. Include copies of manufacturer's and Installer's warranties and maintenance contracts and performance bonds properly executed and signed by an authorized representative.

H. Include copies of all test reports and certifications.

I. Explaining all components of each system including operational features and troubleshooting.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Protection: Use all means necessary to protect materials of this Section before, during, and after installation and to protect installed work and materials of all other trades.

B. Protect and store equipment and materials as required by the Manufacturer, NFPA 70B and as specified herein or on the Drawings. Coordinate with the General Contractor to ensure that suitable controlled environmental conditions are available on site prior to delivery of materials and equipment.

C. Be responsible for the care and protection of all work included under this Section until it has been tested and accepted.

D. Protect all equipment and materials from damage from all causes including theft. All materials and equipment damaged or stolen shall be replaced with equal material or equipment at the option of the Architect and Owner.

E. Materials and equipment stored for this project shall be protected and maintained according to the manufacturer's recommendations and requirements and according to the applicable requirements of NFPA 70B.

1.12 SEISMIC REQUIREMENTS

A. Equipment and work shall meet the restraint requirements for a Seismic Zone - 2 location including installation and connections of material and equipment to the building structure.

1.13 STAGING, SCAFFOLDING AND HOISTING EQUIPMENT

A. Provide, removing when no longer needed, all staging, scaffolding, hoisting equipment and planking required to install the work of this Section of the Specification.

B. Staging, scaffolding, hoisting equipment and planking shall be of approved design, erected and removed by experienced mechanics and workers and shall have accident prevention devices required by Federal, State and local laws.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Electrical Code referred to in these specifications is the Massachusetts Electrical Code. All work shall be provided in strict compliance with the Electrical Code and all regulations that may apply.

B. Where standards exist, for a particular category, products used on this project shall be listed by an OSHA approved Nationally Recognized Testing Laboratory (NRTL) and be approved or listed for the intended service and application.

C. These specifications do not undertake to repeat the requirements of codes, regulations or NRTL listing or labeling instructions. The Specifications or Drawings may require items or work beyond the requirements of applicable codes or regulations. The more strict, higher quality, greater quantity or higher cost shall be provided. It is incumbent on the Installer, material and equipment suppliers to meet these specifications, applicable codes, regulations, and NRTL listing agency restrictions.

D. Manufacturers:

1. The word "Manufacturer" shall include the Manufacturer, the Manufacturer's Representative, the Distributor, the Fabricator, and the Supplier of the particular classification of equipment, system, product, and material.

2. Each and every Manufacturer shall refer to all Sections of the Specifications (Parts One - General, Two - Products and Three - Execution) and Drawings for requirements.

3. Each Manufacturer shall be thoroughly familiar with all specified products relating to the Work and submit written objection prior to bid if he objects to the proposed use of any product.

4. During construction, each Manufacturer shall visit the site periodically to observe the installation of supplied product. The Manufacturer shall advise the Installer and the General Contractor immediately if supplied product is not being installed as recommended by the Manufacturer.

5. Upon completion of the Work, each Manufacturer shall certify in writing that supplied and furnished product was installed according to the Manufacturer's recommendation and the installation is approved by the Manufacturer. Refer to Certifications.

6. Each Manufacturer, when accepting orders for material and equipment, agrees that submittal schedules and production schedules will be adjusted as required to accommodate material and equipment supplied for this project. Material and equipment will be manufactured and delivered to the site sufficiently ahead of schedule so as not to delay the completion of the Work.

7. The Contract Documents are based on the Manufacturer specified. If more than one Manufacturer is listed, the Contract Documents are based on the first Manufacturer named to establish functions, quality, space, and operating features, and all other Manufacturers are considered a substitution.

E. Material, equipment, enclosures, and systems shall be designed for use as required to suit the conditions, exterior or interior operation, dust tight, water tight, explosion-proof, or other special types.

F. Equipment shall have as a minimum a factory coat of non-lead Manufacturer's standard finish paint unless otherwise indicated.

2.2 EQUIPMENT RACKS

A. Refer to GENERAL Section for additional Manufacturer’s requirements.

B. All work, equipment, and systems shall be manufactured, provided, repaired, installed, and tested in accordance with the latest edition and all current amendments of the applicable standard listed below as of the date of the Contract Documents.

1. ANSI/TIA/EIA-310: Equipment Racks and Cabinets.

2. Tripplite open wall mount rack SRW-012-USDP or equal

C. All components shall be provided by the equipment rack Manufacturer.

D. Equipment Racks/Cabinets

1. Equipment racks shall be 19.25 inches wide, 24.5” deep, 12RU high wall mount rack features shall include the following:

a. Universal hole pattern on the front and rear flanges, and threaded mounting holes on both sides of rack assembly for management brackets.

b. Racks shall be extruded aluminum (not sheetmetal) with 10-32 threaded rackrail with numbered spaces. Mounting holes that require supplemental threaded clips are specifically prohibited.

c. The rack shall support a minimum 2000 lb. Static load capacity

d. Mounting brackets specifically designed to support the equipment installed within the rack.

e. Horizontal cable support bar on rear of each patch panel/cross connect block panel to support hook and loop (Velcro) strain reliefs. Cables shall not rely on terminations for cable support.

f. Hook and loop (Velcro®) cable strain relief system on rear of rack to support horizontal and backbone cables. Tie-wraps are specifically prohibited.

g. Hook and loop (Velcro®) horizontal and vertical cable management on front of rack for dressing patch cable. Tie-wraps are specifically prohibited.

h. Hook and loop (Velcro®) cable management system independent of other cable management to properly dress the electronic equipment power cords through the rack maintaining as much clearances between the two as possible. Tie-wraps are specifically prohibited.

i. Bonding and grounding cables for all equipment not directly bolted to equipment rack.

j. All hardware, supplementary steel, channel and supports as required properly assembling the rack and supporting it as necessary.

k. All equipment racks and their hardware shall match in appearance and shall be provided by a single manufacturer.

2.3 CABLE SUPPORTS

A. Refer to GENERAL Section for additional Manufacturer’s requirements.

B. Provide products meeting the requirements of the Drawings and Specifications from one of the following manufacturer's:

D-Rings:	B-Line, Harrison/Dracon, Nelson, Mono-System, Minerallac,.
J-Hooks:	B-Line, Harrison/DraconNelson, Mono-System, Minerallac,.

Hook and Loop Fasteners:	B-line, Minerallac, Siemons
Beam Clamps:	Burndy, Minerallac, Kindorff, Steel City, OZ/Gedney
Split Mesh Strain Reliefs (Kellums):	Hubbell, Woodhead

C. Hook and loop fasteners shall be designed for their specific application.

D. Tie-wraps:

1. Plastic cable ties are specifically prohibited in headend rooms or multimedia panels.

2. Cable ties can otherwise be used in support applications. Where used in plenum spaces, the tie-wraps must be plenum rated.

3. The plastic cable ties must be applied in such a manner that they can be adjusted by hand after installation.

E. Beam clamps shall be steel with threaded bolt type closure. Spring steel or "quick-clip" type clamps are specifically prohibited.

2.4 DIGITAL MEDIA INPUT PLATES AND RECEIVER:

A. Description

1. The signal transmitters shall extend HDMI video, audio, and data over a single UTP/STP cable to compatible transmission receiver modules or ports. The following source formats shall be supported:

a. HDMI

b. DVI-I

c. RGBHV

d. VGA

e. YPbPr

f. Y/C

g. Composite

h. Analog 2-channel audio

i. USB HID (Human Interface Device)

2. Switching:

Transmitter shall include integrated switching with signal sensing.

a. Switching modes:

1) Automatic: switcher shall switch to the last detected input.

2) Controlled: control processor controls source switching and audio break-away switching.

B. Basis of design product: Crestron **DM-TX-200-C-2G** Digital Media transmitter. Crestron DM-RMC-4K-100C Digital Media Receiver

C. Performance

1. The transmitter shall meet the following minimum requirements:

a. One (1) HDMI video, audio, and control input:

1) Supports HDMI.

2) Supports HDCP.

3) Supports Dolby Digital, Dolby Digital EX, DTS, DTS-ES, DTS 96/24, up to 8 channel PCM.

4) Supports DVI-D with adaptor.

5) Supports Dual-Mode DisplayPort.

6) CEC device control.

b. One (1) DB15 input:

1) Component (YPbPr)

2) RGB

3) S-Video (Y/C)

4) Composite Video

c. One (1) analog stereo audio input:

1) (1) 3.5mm TRS (L/R unbalanced)

d. One (1) USB HID port.

1) Supports USB HID class devices

e. Single UTP/STP cable transmission connection

1) Supports HDBaseT signal specifications.

2) Supports remote power injection through matrix switcher.

3) Supports CAT5e.

4) Signal transmission up to 330 feet.

f. Power supply modes:

1) Remote power supplied by matrix switcher through UTP/STP transmission cable.

2) Local or remote DC power source.

g. Mounting:

1) 2-gang wall box mount.

2) 2-gang floor box mount.

Acceptable Manufacturer- Crestron DM-TX-200-C-2G-B-T transmitter and Crestron DM-RMC-4K-100C Receiver

D. The input plates shall be single gang faceplate- Extron MLC62RS-D.

E. Provide 18/4 shielded cable for in wall and plenum ceiling installation

2.5 PASS THROUGH INPUT PLATES:

A. The pass through input plates in each room shall be a single gang HDMI and USB faceplate.

2.6 AIR MEDIA WIRELESS GATEWAY

A. General Functionality

1. Content View

a. The device shall support dual source view of two separate content devices.
b. Content view shall support a light theme and a dark theme background.

B. User Support

1. Status of connected user shall be viewable on status page.
2. The device shall support up to ten connected presenter users.

C. The Gateway shall be fully functional as a stand-alone source device when used with a connected display and supported networked mobile device or desktop/laptop.

D. Gateway shall support presentation of content from multiple connection types

E. Acceptable Manufacturer- Crestron AM-3200 with air media dongle

2.7 SPEAKERS:

A. The loudspeaker shall be 60 watts, full range loudspeaker system utilizing one 6.5" woofer and one 1” silk dome tweeter

B. The loudspeaker shall have a nominal rated impedance of 8 ohms and shall be wired in parallel with a line voltage matching (step-down) transformer with a level selector appropriate for various output taps. The loudspeaker input connections will allow for direct connection to 70 volts, amplifiers.

C. The loudspeaker shall have a protection circuit to protect the product from occasionally being overdriven. Each loudspeaker shall have a Frequency range of 55 Hz – 20 kHz. The speaker sensitivity shall be 91dB at 1 watt for 1 meter. The input connection shall consist of screw down removable locking clip-in connector.

D. Power settings available shall be: 7.5,15,30, and 60 watts at 70 volts; 15, 30, and 60 watts at 100 volts. The nominal dispersion shall be 120° conical coverage pattern, consistent broadband.

E. The loudspeaker shall be plenum-rated for use in air handling spaces. The loudspeaker shall meet numerous standards for combination music and evacuation systems around the

world. Exposed cosmetic surfaces of the loudspeaker shall be paintable, and the acoustically transparent grille component shall be formed of powder-coated steel.

F. The loudspeaker shall be 60 watts, full range loudspeaker system utilizing one 6.5" woofer and one 1” silk dome tweeter

G. The loudspeaker shall have a nominal rated impedance of 8 ohms and shall be wired in parallel with a line voltage matching (step-down) transformer with a level selector appropriate for various output taps. The loudspeaker input connections will allow for direct connection to 70 volts, amplifiers.

H. Provide all additional mounting brackets as required for proper installation

I. Acceptable Manufacturer

1. Crestron IC6T-W-T Ceiling speakers
2. Or Approved equal

2.8 AV MULTI-FUNCTION PRESENTATION PROCESSOR

A. The Presentation Processor unit shall be a single unit composed of internally integrated components providing multiple functions. Included sub-components:

1. Front Panel Control Interface shall provide basic control of the Presentation Processor.

a. Audio Matrix/Mixer

b. Audio Amplifier

c. Video Matrix

d. Single Cable Transmission

e. Control Processor

2. Built-In Device Configuration Software
   a. Configuration Software
      1) Software shall support the following:

         a) System configuration through web browser, specialized software shall not be required.

         b) System Configuraiton shall include:

            (1) Source setup

(2) Display setup

(3) User Interface setup

(a) Manufacturer shall provide multiple user interface options.

(4) Add occupancy sensor option

(5) Add network management integration

c) Security Requirements:

(1) Secure access through full user/group management or Active Directory integration

(2) Hardware level security using 802.1X authentication

(3) TLS, SSL, SSH, and SFTP network security protocols

d) Deployment

(1) A single configuration file shall be network deployable to multiple rooms.

B. Video System

1. Video Inputs

a. Video inputs include HDMI and HDBaseT type input.

1) HDBaseT type inputs shall be compatible with HDBaseT and manufacturers proprietary format supporting additional control functionality.

2) HDMI inputs are compatible with DVI and Dual-Mode DisplayPort sources

2. 4K Video Switcher

a. Built-in video matrix switching allows video sources to be routed simultaneously to output connectors.

b. Internal switcher shall support routing of HDMI and other AV sources to HDMI and HDBaseT outputs.

c. The HDMI outputs are compatible with DVI and the HDBaseT outputs are compatible with HDBaseT and manufacturer proprietary format supporting additional control functionality.

d. 4K/60 Video Scaling - Unit shall include an independent, 4K scaler on each HDMI output.

C. Audio System

1. Audio Inputs - Each HDMI and analog audio input includes adjustable input compensation to accommodate a range of signals and maintain consistent volume levels when switching between sources.

2. Audio Amplifier - Unit shall include a built-in power amplifier.

a. Amplifier shall support three mutually exclusive amplifier modes.

1) 100V mode: mono, 40 Watts RMS per channel.

2) 4 ohm, 8 ohm mode: Stereo, 20 Watts RMS per channel at 4 ohms or 8 ohms.

3) 70V mode: mono, 40 Watts RMS per channel.

3. Audio Matrix Functions:

a. Any analog input, digital audio input, or HDBaseT audio input signal shall be routable to:

1) Amplified Speaker Output

2) Analog line level outputs

3) HDBaseT type output

4) HDMI output

4. Microphone Preamplifier

a. Microphone Inputs - Each internal microphone preamplifier input shall be connected to two mutually exclusive input connections:

1) Detachable terminal block - Balanced microphone level analog audio with switchable 48 volt DC phantom power.

2) Detachable terminal block - Balanced or unbalanced line level analog audio.

5. Audio Mixer

a. All stereo audio outputs shall be capable of outputting independent microphone and program audio mixes.

1) All stereo sources and microphone sources shall be available simultaneously.

2) All stereo sources and microphone sources shall have controllable levels in mixed output signal.

6. Audio DSP

a. Each analog audio output shall include DSP processing, allowing each output to be configured separately. DSP parameters include:

1) real-time adjustable volume, bass, treble, and mute controls

2) 10-band graphic equalization

3) 4-band parametric equalization

4) Adjustable limiting

5) Up to 85 ms of speaker delay adjustment

D. Single Cable Transmission System

1. HDBaseT type inputs and outputs allow for connecting to remote sources and display devices, and integrating with larger systems via a single CAT5 type cable.

2. The one-wire interface supports transmission of ultra high-definition video, audio, control, power, and networking signals over CAT type cable at distances up to 330 feet (100 meters).

3. Unit shall be HDBaseT Certified

a. The processor shall be designed using HDBaseT Alliance specifications, and shall support interoperability with other HDBaseT certified products.

E. Control Processor

1. Unit shall include a built-in control processor with onboard control ports for control of external devices.

2.

3. The Central Switching And Control Unit shall include an integrated microprocessor based control processor.

4. The built-in control processor shall support customizable control of integrated AV devices, room lighting hardware, window shades, and projection screens.

5. Controller shall include the following onboard control ports:

6. Ethernet

7. Four IR ports

8. Two RS-232 COM ports

9. Four relay ports

10. Four digital input ports

11. RS-422 type network control bus

12. Control Subnet Networking
    a. Unit shall include a built-in control subnet network port.

13. The controller shall support a network management system by the same manufacturer, supporting overall remote system controlling, monitoring, and managing through network computers and mobile devices.

14. The controller shall support touch screens, keypads, and wireless remotes and mobile device Apps from the same manufacturer.

F. Multimedia Presentation Gateway
1. General Functionality

    a. Gateway shall support presentation of content from network connected devices.

2. Architecture

    a. Gateway functionality shall be a built-in function.

3. Communication

    a. Dedicated LAN Connection

        1) 10/100 Mbps, auto-switching, auto-negotiating, full/half duplex, DHCP, SSL, TLS, SSH, SNMP, IPv4, HTTPS web server

4. User Device Support

    a. Gateway shall support connection of up to 32 user devices for presentation.

    b. Gateway shall support multiple user device types and Operating Systems:

        1) Laptop and desktop computers:

            a) Windows XP, Windows Vista, Windows 7, Windows 8, Window 10, Mac OS X (versions 10.5 thru 10.11)

        2) Mobile Devices:

            a) Apple iOS, Android

5. Audio

    a. Audio Format: Stereo

6. Video

a. Video Frame Rate Supported: 15 fps (typical)

b. Supported Resolutions

800x600@60Hz, 1024x768@60Hz, 1280x720@60Hz (720p60), 1280x768@60Hz, 1280x800@60Hz, 1280x1024@60Hz, 1360x768@60Hz, 1400x1050@60Hz, 1440x900@60Hz, 1600x1200@60Hz, 1920x1080@60Hz (1080p60), 1920x1200@60Hz

G. Acceptable Manufacturers

1. Crestron DMPS3-4K-350-C
2. Or approved equal

2.9 PROJECTOR

The Projector shall have the following features:

1. 4500 ANSI Lumens
2. WXGA resolution (16:9 aspect ratio)
3. High efficiency Blue Laser Phosphor with 20,000 hours
4. 2 HDMI inputs, 1 DVI (digital only, 1-HD15, 3.5mm stereo female for serial communications, 1- HDBaseT, 1- RJ45 (control)
5. RS232 in
6. Adjustable, motorized horizontal and vertical lens offset, motorized zoom and focus adjustment

B. Acceptable Manufacturers

1. Epson Powerlite L210W with Chief

2. Or approved equal

2.10 PROJECTION SCREEN

1. The Projector Screens shall conform to the following:

a. The projector screens shall be an electric ceiling mounted with low voltage control faceplate at 48”

b. The projection screens shall be 159.5” nominal Diagonal with a black drop of 2.00 inches, a viewable height of 78” and a viewable width of 139”

c. The projection screens shall be Matte white with a standard bottom border

d. The projection screens case shall be white, the case length shall be 158” with flange. Provide SCB-100 in internal junction box with VPI

e. The projector shall be controlled by the presentation switcher and touch panel at the front of the room.

f. Provide all mounting hardware and supports. Coordinate power and exact location in the meeting room with the architect.

Acceptable Manufacturer: Da-Lite Advantage Deluxe

2.11 WIRELESS MICROPHONE SYSTEM

A. The digital wireless system shall operate in the VHF, UHF, ISM (900 MHz), 1.2 GHz, 1.5 GHz, or 1.8 GHz band with the specific range being dependent on the user's locale. The system shall include the option of changing the operating frequency in order to avoid RF interference. Preconfigured group, channel and frequency setups shall be available to ensure that multiple systems in use do not interfere with one another.

B. Provide a bodypack transmitter for use with the lapel microphones,

C. All transmitters shall be powered by either a Lithium Ion rechargeable battery or 2 AA batteries and shall have a power on/off switch with LED status indicator. When operated with the rechargeable battery, the system shall display remaining run time in hours and minutes (accurate to within 15 minutes), percentage health, percentage charge, charge cycles, and temperature. Provide charging pack for the body packs transmitters and microphones.

D. The transmitter front end shall optimize itself for standard inputs without requiring transmitter gain adjustments thus allowing all gain changes to be made at the receiver, which shall provide a 60 dB range of system gain. Overall system signal to noise ratio shall be >120 dB.

E. Provide a quad-channel rackmount receiver. quad-channel receivers shall include Dante™ digital audio networking in addition to analog audio outputs. All receivers shall include DC power on the RF inputs for use with directional antennas and antenna distribution components.

F. The receiver shall include an RF level meter, an audio level meter, and a Networking Interface connector for computer control and monitoring. The system shall detect RF interference and indicate such to the user via the LCD and RF meters. The system shall use technology such as digital predictive diversity to optimize RF stability.

G. The system shall include always-on AES-256 encryption that cannot be disabled. The encryption scheme shall conform to the US Government National Institute of Standards and Technology (NIST) publication FIPS-197. The encryption mechanism shall utilize a randomized key that is not transmitted via RF.

Acceptable Manufacturer: Shure ULXD4D Digital Wireless System.
Provide (2) SMB8 handheld microphone
(2) MX184 lapel microphone with UXD-1 body pack
(2) ULXD6 boundary microphone
(2) Shure UA874 remote antenna and cable.
(2) Shure SBC 203 charger

2.12 TOUCH SCREEN CONTROL

A. The touchscreen controls shall provide the following for the room as indicated on the drawings.

1. Each touch screen control shall indicate the room position (on/off). On the wake-up screen with background logo (coordinate with the owner for the back ground logo). The wake-up screen shall also provide for on/off and projection screen indication of position. When the projector and screen are activated, the shades for the room shall close and the front of the room lights turned off (coordinate the presets with the shade and lighting contractors). When the room is set to the appropriate parameters the touch screen shall move to the next page and indicate the input activation for the room(s) The page shall also provide for room off indication without having to revert to the first page. The next page shall provide for the audio control of the rooms for program audio. This page shall also provide for off controls without reverting back to the other pages.

B. Device Architecture - The Touch Screen UI shall be composed of the following functional elements:

1. Graphical touch video display

2. Programmable capacitive buttons

1. Ambient light sensor

2. Built-In camera

3. Built-in microphone

4. Built-in speakers

5. Built-in Bluetooth iOS device proximity beacon

3. Graphical Display

1. Graphical UI - Touch screen UI display shall support the following viewable elements:

a. Control buttons and objects

b. Feedback indication via text, button object changes in color, animated object or graphical element.

c. H.264 or MJPEG Streaming video

4. Brightness Control - Graphical UI shall automatically adjust screen brightness based on room ambient light levels.

1. Touch UI Functions

2. Touch Screen UI shall support Multi-Touch control interfacing.

3. Touch Screen UI shall support gesture driven controls through custom programming and configuration.

5. Functions - The Touch Screen UI shall include:

1. Custom Control UI - control of integrated system components through custom programming or preset configuration of the system control processor by same manufacturer.

2. System Integration - device shall support controls for compatible integrated AV systems, HVAC and Lighting hardware, and scheduling and management systems.

3. Audio Intercom via Ethernet network.
4. Custom audio feedback via custom programming.

5. Multi-Language support

6. Internet Browsing shall be supported via Ethernet network.
7. Voice Recognition - device shall support voice commands control functionality through custom programming and configuration of the system control processor.

6. Communication and Power

1. Communication: Bidirectional 10/100 Mbps Ethernet communication.

2. Power: IEEE 802.3af Class 3 PoE Powered Device

7. Physical

1. Touch Screen UI shall be available in the following sizes:

a. 7-inch TFT active-matrix color LCD touch screen 1024 by 600 WSVGA resolution display.

b. 10.1-inch TFT active-matrix color LCD touch screen 1280 by 800 WXGA resolution display.

2. Touch Screen UI shall include five programmable backlit capacitive control buttons.

3. Wired Connection - Device shall utilize a single wired connection for power and data communication.

Acceptable Manufacturer- Crestron TSW-1070-B-S

2.13 AUDIO AMPLIFIERS

A. MULTI-CHANNEL AUDIO AMPLIFIER

1. The amplifier shall include advance audio controls to service low impedance and high impedance speaker configurations.
2. The amplifier shall deliver the following:
   - Lo-Z (4/8 Ω) and Hi-Z (70V or 100V) Output
   - 4-channel amplifier (75 W / channel) that can also be configured for:
     - 3-channel bridged operation (150 W bridged channel, 75 W / single ended channel)
     - 2-channel bridged operation (up to 150 W / channel)
     - 1-channel bridged operation (up to 300 W)
3. The amplifier shall have an input sensitivity of 1.29V, +4dBu balanced for the rated power

B. Physical

1. The amplifier shall be in a 1RU EIA standard enclosure for rack mounting
2. Unit depth shall be 11.03 inches, Width: 9.38 in., Height: 1.74 in.
3. The internal fan cooling shall provide side-to-side airflow
4. The amplifier shall have a front panel bi-color LED to indicate unit status
   a. Connection to AC mains
   b. Connection to a LAN.
5. The amplifier shall have front panel LED status indicators
   a. Fault
   b. Over Current
   c. DC
   d. Thermal
   e. High impedance output selected
6. The amplifier shall have a series of front panel LED output indicators
   a. Indicating signal Clip
   b. Indicating signal level of -40dB, -30dB, -20dB, -10dB
7. The front panel Reset shall return the unit to the last saved configuration
8. The rear panel LAN connector shall provide network communications
9. The rear panel attenuators shall control the 8 analog outputs
10. Rear support brackets shall be provided for rack attachment
11. The amplifier shall include a Universal Power Supply
    a. Operational 50-60Hz, 100-240VAC.

C. Audio I/O

a. The amplifier shall provide 8 balanced input connections, line level
b. The amplifier shall provide 8 speaker level output connections
c. The amplifier shall provide 70V high impedance outputs for distributed speaker systems
d. High impedance outputs shall be direct coupled
e. High impedance mode selection shall be available in the Amplifier software tool
f. A front panel indicator LED shall illuminate when in high impedance mode

D. Audio Configuration
1. The amplifier object in the Amplifier software tool shall be configurable for instant audio delivery.
2. The amplifier software tool presets shall recall any system configuration
3. The amplifier software tool views shall recall any system control screen configuration
4. The amplifier object in the software tool shall provide:
a. Stereo grouping of adjacent channel pairs
b. Bridging of adjacent channel pairs
c. Output level control
d. Mute
e. Status indicators for Clip, DC Protect, Over Current & Thermal events

E. User Interface Export
1. Graphic control elements including digital attenuators and VU meters shall be user selectable and exportable directly from the amplifier software tool.
2. The User Interface Export file shall enable the building of touch panels with a drag and drop process.

F. Acceptable Manufacturers

1. Crestron AMP-X300
2. Or approved equal

2.13 AUDIO VISUAL LOCAL AREA NETWORK SWITCH:

A. Provide Crestron CEN-SW-POE30 layer 3 managed network switch for the AV LAN
A. The network switch shall have the following features:
g. Ports (2) 10/100/1000Base-T auto-sensing Gigabit Ethernet (24) 10/100/1000Base-T auto-sensing Gigabit Ethernet w/PoE+ (4) 10 Gigabit Base-X SFP+ Network Standards IEEE 802.3af, 802.3at MAC Addresses Up to 16K Switch Fabric 132 Gbps non-blocking

h. Management Out-of-band; IT Web GUI (main); HTTPs, CLI, Telnet, SSH; SNMP, MIBs, RSPAN; Radius users, TACACS+ IPv4/IPv6 ACL and QoS Ingress/egress; 1 Kbps shaping, time-based; Single rate policing IPv4/IPv6 Multicast Filtering Automated IGMP between switches; IGMPv3 MLDv2 snooping, proxy ASM and SSM; IGMPv1, v2 querier (compatible with v3); Control packet flooding IPv4/IPv6 Policing and Convergence Auto-VoIP; Policy-based routing; LLDP-MED; IEEE 1588 PTPv2 IPv4/IPv6 Authentication Security Successive tiering (DOT1X, MAB, Captive portal); DHCP snooping; Dynamic

ARP inspection; IP source guard IPv4/IPv6 Static Routing Port, subnet, VLAN routing; Multicast static routes; DHCPv4 server; DHCP relay; Stateful DHCPv6 Server IPv4/IPv6 Dynamic Routing IPv4: RIP; IPv4/IPv6: PIM-SM, PIM-DM, SSM Spanning Tree Green Ethernet STP, MTP, RSTP; PV(R)STP; BPDU/STRG; EEE 802.3az

i. OOB (1) 8-wire RJ45, female; 10/100/1000Base-T Ethernet port CONSOLE (1) 8-wire RJ45, female USB-C USB-C® port, female 100-240V (1) power connector USB USB Type A, female LED EXT USB-C® port, female 1-24 (24) 8-wire RJ45, female; 10/100/1000Base-T Ethernet ports and PoE Power Sourcing Equipment (PSE) outputs; Supports IEEE 802.3at Type 2 PoE+ power sourcing from any ports up to the maximum specified power capabilities; Maximum 30 Watts per port, 480 Watts total 25-26 (2) 8-wire RJ45, female; 10/100/1000Base-T Ethernet ports. 27-30 (4) SFP+ ports, female; 10 Gigabit Base-X SFP+

2.14 INTEGRATED SOUNDBAR MICROPHONE AND CAMERA

A. Provide integrated soundbar microphone and camera as indicated on the drawings.

1. The integrated soundbar, microphone and camera shall be Jabra Panacast 50 black with wall mount adapter.
   a. Refer to AV drawings for additional information.

2.15 DISPLAYS

A. Refer to GENERAL Section for additional Manufacturer’s requirements.

B. The displays for the lounge/meeting room 113 & computer room 106 shall be 75” diagonal 4K UHD with 232C control

1. The displays shall have a native resolution of 3840x2160 with a brightness of 700 nits and viewing angle of 178*/178* with a non-glare panel

2. The displays shall be Crestron certified.

3. The displays shall have the following inputs:

   a. 1-displayport 1.2 DVI-D
   b. 2-HDMI 2.0
   c. HDCP 2.2
   d. 2-USB 2.0
   e. RS232

4. The displays shall have a dimension of 66.2” x 37.8” x 1.9” and 400 x 400 vesa mount

5. Acceptable Manufacturer
   a. Samsung QH75R
   b. Sony 75BZ40L
   c. Or approved equal

C. The displays for the Zoom meeting rooms shall be 32” diagonal 4K HDR with 232C control.

1. The displays shall have a native resolution of 3840x2160 with a brightness of 300 nits and viewing angle of 178*/178* with a non-glare panel

2. The displays shall be Crestron certified.

3. The displays shall have the following inputs:

a. 1-displayport 1.2 DVI-D
b. 4-HDMI 2.0
c. HDCP 2.3
d. 2-USB 2.0
e. RS232

The displays shall have a dimension of 32”: 726mm x 430mm x 76mm and 100 x 200 vesa mount,

4. Acceptable Manufacturer
a. Sony FW-32BZ30J
b. Or approved equal

2.16 CABLE PROTECTION

A. Refer to GENERAL Section for additional Manufacturer’s requirements.

B. Cables installed in enclosed bays or furred spaces where conduit stubs are not provided, shall be protected from chafing or any damage. The Installer shall verify that the warranty shall not be violated before installing any cabling in these locations.

C. Provide bushings in all metal studs and other openings where cables pass through. Bushings shall be of two (2) -piece construction with one piece inserted through the openings and the second piece locking it into place. Single piece bushings with locking tabs or friction fit are specifically prohibited.

D. Provide sleeves and bushings and seal as required at all penetrations.

E. Cables damaged during installation shall not be repaired. They shall be completely replaced with new cable.

F. Provide raceway for cabling installed exposed (not behind building finishes) or where subject to damage or abuse.

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to bid, inspect the site, existing conditions, fully understand the Work required, and provide the Work per Contract Documents and all existing site conditions. Confer with the Manufacturer's of existing systems to be retained, modified or extended. Include all required costs and components for a fully functional system performing as indicated herein and on the Drawings. No additional compensation will be granted because of existing conditions.

B. Verify the exact location prior to bid of all items that may be indicated and determine exact location of all items that are not indicated on the Drawings.

C. Any work installed contrary to the Contract Documents or written directions from the Architect shall be subject to change as directed by the Architect and no extra compensation will be allowed for making these changes or any work of any other trade due to these changes.

D. Include the cost of all work including sub-letting of any work that may be required to complete the work indicated in order to avoid work stoppages and jurisdictional disputes. The work to be sublet shall conform with precedent agreements and decisions of record. Jurisdictional assignment shall be a responsibility under this Section's contractual obligation.

E. Do not install equipment and materials, which have not been reviewed by the Architect. Equipment and materials which are installed without the Architects review or without complying to comments issued with the review shall be removed from the project when so instructed by the Architect. No payment will be made for unapproved or removal if it is ordered removed. The Installer shall be responsible for any ancillary costs incurred because of its removal and the installation of the correct equipment and materials.

F. Manufacturers:

1. Manufacturers shall refer to all parts of the Project Specifications and Drawings to familiarize themselves with all project requirements and include, in cooperation with the Installer, all associated costs.

2. During construction, each Manufacturer or an authorized Representative shall visit the site periodically to observe the installation of projects furnished. Immediately notify the Installer in writing if products are not being installed as recommended by the Manufacturer of the product. Provide copy of notice to the General Contractor and the Architect.

3. Upon completion of the work, each Manufacturer shall certify the installation as indicated under "CERTIFICATES OF APPROVAL".

4. When a Manufacturer, or authorized Representative accepts an order for material and equipment, they agree to adjust Submittals and production schedules as required to accommodate the project schedule. Schedules shall be included with Submittals indicating review times as specified herein and manufacturing and delivery times such that material and equipment will be manufactured and delivered to the site sufficiently ahead of schedule so as not to delay the completion of the work.

G. At the start of construction, consult with the General Contractor and all Trades and determine and verify the telecommunications requirements and characteristics of all equipment which is supplied under the Contract.

H. Request, in writing, that the General Contractor and each Trade prepare and submit to this Section a complete list of all equipment which they are supplying under their respective Sections which require or effect work under this Section.

I. Obtain detailed information on installation requirements from the manufacturers of all equipment to be furnished, installed or provided. At the start of construction, check all Contract Documents including all Drawings and all Sections of the specifications for equipment requiring connections and service and verify characteristics of equipment prior to roughing.

J. Request the General Contractor to provide, as soon as possible after approval, two copies of approved submittals of equipment which require or effect the work of this section. Review these submittals for characteristics and return the submittals to the General Contractor noting any non-agreement within two weeks of receipt.

K. Equipment and systems shall not be installed without first coordinating the location and installation of equipment and systems with the General Contractor and all other Trades.

L. Any and all material installed or work performed in violation of above requirements shall be re-adjusted and corrected by the Installer without charge.

M. Refer to all Drawings associated with the project, prior to the installation or roughing-in of the work and to determine the exact location of all outlets.

N. Assure that all equipment is accessible, such as junction boxes, pull boxes, and such other apparatus as may require maintenance and operation from time to time. Provide necessary construction access panels sized to provide adequate and required access for installation by the General Contractor. Provide rated panel or door appropriate for the construction being installed into (fire, smoke and/or acoustical).

O. After installation, equipment shall be protected to prevent damage during the construction period. Openings in conduits and boxes shall be closed to prevent the entrance of foreign materials.

P. Home runs indicated are not to be combined or reduced without written consent from the Architect.

Q. Cables and raceway sizes indicated shall be continuous throughout circuit unless otherwise indicated.

R. All connections to equipment shall be made as required, and in accordance with the approved submittal and setting drawings.

S. Delivery, Storage and Handling:

1. Deliver, store, protect and handle products in accordance with recommended practices listed in Manufacturer's Installation and Maintenance Manuals.

2. Deliver equipment in individual shipping splits for ease of handling, mount on shipping skids and wrap for protection.

3. Inspect and report concealed damage to carrier within specified time.

4. Store in a clean, dry space. Maintain factory protection or cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. Heat enclosures to prevent condensation. Meet the requirements and recommendations of NFPA 70B and the Manufacturer. Location shall be protected to prevent moisture from entering enclosures and material.

5. Handle in accordance with NEMA and the Manufacturer's recommendations and instructions to avoid damaging equipment, installed devices and finish.

6. The equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the Manufacturer shall be required to brace the equipment suitably to insure that the tilting does not impair the functional integrity of the equipment.

T. Site Observation:

1. Site observation visits will be performed randomly during the project by the Architect. Reports will be generated noting observations. Deficiencies noted on the site visit reports shall be corrected. All work shall comply with the Contract Documents, applicable Codes, regulations and local Authorities whether or not a particular deficiency has been noted in a site visit report.

2. Be responsible to notify the Architect ten working days prior to closing in work behind walls, raised access floors, ceilings, etc., so that installed work can be observed prior to being concealed.

3. Work concealed prior to observation and correction of deficiencies shall be made accessible for review at the discretion of the Architect. Bear all costs for allowing worked to be reviewed.

4. Areas shall stay accessible until deficiencies are corrected and accepted. Notify the Architect when all deficiencies are corrected. Return reports with items indicated as corrected prior to re-observation by the Architect.

U. Change Orders, Modifications, Revisions and Directives:

1. When change orders, modifications, revisions or Architect's Directives are issued or authorized, provide the required additional material, equipment, personnel and workers to prevent delays in the work, and to complete the work within the time limit of the Contract unless a specific time extension is requested with the change and accepted. Include costs for expediting deliveries where required.

2. Requests for additional compensation shall be submitted broken down and associated by item, tasks and Drawing or sketch number with material and labor costs, so quantities can be easily verified.

3. Requests shall be properly and adequately identified so the scope of work can be clearly determined. Indicate who originated change in work.

4. Cost break downs shall be submitted complete with backup for material and labor units and costs. Backup shall consist of actual vendor invoices or quotes, or from well known national organizations such as R.S. Means Company, National Trade Service, Union labor rates or approved equal. Installing firm's in-house standard database for labor units may be used if consistent with the national organizations.

5. Submit on all credits broken down as requested for adds. Credits shall be separately identified and accounted for. Do not indicate as net changes with adds.

6. Unit costs for labor and material shall be equal for adds, deletes and credits.

V. Schedule of Values:

1. Provide a schedule of values breaking down the contract price when requested.

2. The schedule of values shall be submitted for review and acceptance prior to the paying of any invoice.

3. The schedule shall accurately reflect the actual costs for each category including allocation for overhead and profit.

4. Provide a schedule of values as required by the Contract Documents, the General Contractor and the Architect. As a minimum, provide the following breakdown as indicated here (by phase where applicable):

   a. Material and labor for each item.

   b. Follow the Architects cost estimate format and breakdown (request a copy from the Architect through the General Contractor).

   c. Each major piece of equipment.

   d. Other equipment by category.

   e. Equipment installation by category and each major piece of equipment.

   f. Underground work.

   g. Roughing work.

h. Finish work.

i. Coordination.

j. General Conditions.

k. Bond.

l. Testing.

m. Owner training.

n. Operation and Maintenance Manuals.

o. Record drawings.

p. Acceptance Demonstrations.

3.2 EQUIPMENT RACKS AND BRACKETS

A. Securely mount equipment racks, cabinets and wall mounted relay brackets to the building structure. Provide Seismic bracing for Seismic Zone 2. Proper supports such as 3/8" lag screws and expansion anchors shall be used. Proper quantity of supports shall be utilized. Dry wall screws and other types of supports not specifically approved to support equipment are specifically prohibited. Submit mounting supports for approval before installation.

B. Position racks and cabinets in order to have minimum 42” clearance for easy access. Equipment racks, cabinets, and relay brackets mounted on or against walls shall have 42” clearance. Equipment racks and cabinets shall have 42” clearance in front and rear. Provide 3-foot clearance between equipment racks or cabinets and any other obstruction to allow access from front to rear of rack or cabinet for maintenance.

C. Provide cable tray over each rack as required to facilitate a neat and orderly installation of cables and to secure the top of the racks to the structure. Cables shall drop straight down with proper bend radius support (i.e. waterfalls) to equipment racks. Cable trays shall be secured at both ends to the structure and connected together as required for a complete contiguous installation. Utilize proper supports to support the cable tray to the building structure as well as the equipment rack and cabinet. Submit mounting supports for approval before installation.

D. Install terminating components such as patch panels cable management, etc., into the racks, cabinets and wall mounted relay brackets.

E. If the building size or layout is such that, given the segment length restrictions, then additional racks shall be placed in remote Telecommunications Rooms or equipment cabinets shall be provided to satisfy all network requirements.

F. Coordinate power requirements with the General Contractor. It is this section’s responsibility to provide additional power requirements for their equipment that has not been provided in the Drawings and Specifications of Division 260000.

3.3 TERMINATIONS

A. All copper and fiber conductors of every cable shall be completely terminated at both ends.

B. Terminations shall be as indicated under the type of cabling specified in Part Two of the Specifications.

3.4 CABLE PATHWAYS

A. Install cables in pathways provided under Section 260000 or required under the execution part of this section.

B. Provide all equipment and cabling for a complete installed operating system. In general, pathways, outlet boxes and grounding are provided under Section 26 00 00. However, it is the Installers responsibility under this Section to coordinate with the Drawings and Specifications for Section 260000 and to provide all pathways and outlet boxes required that are not provided under Section 260000.

C. All pathways provided under this Section shall comply with fill capacities as per the Electrical Code

D. Cable bending radius shall not be less than minimum required by EIA/TIA

E. Cabling installed concealed shall be supported from the building structure (e.g. cable trays, "J" hooks, etc.).

F. At a minimum, exposed cabling, and support fastening mechanisms installed in return air plenums shall be plenum rated.

G. Cables shall be installed no closer than 12 inches (305mm) to electrical equipment and wiring. When cables are required to cross power wiring, they shall only do so perpendicular to the power wiring. A/V cabling and power wiring shall only cross each other the minimal number of times as required due to building design limitations.

H. Clearances: Clearances between cabling and other building systems as required by ANSI/TIA/EIA-569-A shall be maintained throughout the building.

I. All cables shall be installed in a neat and workman-like manner. Cables shall be installed parallel and perpendicular to building elements.

3.5 FIRE, SMOKE, ENVIRONMENTAL AND ACOUSTICAL SEALING OF PENETRATIONS AND OPENINGS

A. Environmental Seals

1. Provide seals on raceways exposed to widely different temperatures, as in refrigerating or cold storage areas. Install seal to prevent circulation of air from warmer to colder sections through the raceway.

2. Provide seals under device plates for outlets on walls between conditioned and non-conditioned spaces.

B. Smoke and Fire Stopping Seals

1. Provide a seal around raceways or cables penetrating full height walls (slab to slab), floors or ventilation or air handling ducts so that the spread of fire or products of combustion shall not be substantially increased.

2. Penetrations through fire-resistant-rated walls, partitions, floors or ceilings shall be firestopped using approved methods and NRTL listed products to maintain the fire resistance rating.

3. Installation restrictions of the listing agencies shall be strictly adhered to (e.g. 24 inch (610 mm) minimum horizontal separation between boxes on opposite sides of the wall, maximum square inch opening in wall).

4. Fire stopping in sleeves or in areas having small openings that may require the addition or modification of installed cables or raceways shall be a soft, pliable, non-hardening fire stop putty. Putty shall be water resistant and intumescent.

5. Firestopping in locations not likely to require frequent modification shall be a NRTL listed putty to meet the required fire resistance rating.

6. Box penetrations into a fire rated wall or shaft shall have a firestopping putty pads installed on the back of the outlet box.

7. Temporary firestopping of cable trays through walls shall be with NRTL listed bags (normally not approved as permanent firestop system) to meet the required fire resistive rating and that will not allow products of combustion to pass through the protected opening. The NRTL listed bags shall be installed inside and on both sides of the opening as required to meet the required resistive fire rating of the wall.

8. Firestopping materials shall be NRTL listed to UL 1479 (ASTM E-814). Installation methods shall conform to a UL® listed firestopping system. Submit specifications and installation drawings for the type of material to be used. Firestopping materials shall be as manufactured by 3M, International Protective Coatings Corp., Specified Technologies, Inc., Carborundum Company, RayChem, Nelson Fire Stop or approved equal.

3.6 INSTALLATION

A. Provide all programming to all equipment for a complete installation. Coordinate the touch panel look with EMC and provide all integration with EMC provided content servers.

B. The programming of all equipment shall be coordinated with EMC 30 days before system is complete.

C. Coordinate the placement of projectors in the Gyp board ceilings with the GC and test all placements with the desired view on the screens or walls before the ceiling is painted. Coordinate the placement of access panels for the in ceiling projectors and the Flexible picture equipment.

D. Coordinate the placement of all projectors in the briefing rooms so there is no conflicts with other ceiling mounted devices.

E. All cabling shall be installed in conduit or cable tray where indicated on plans or shall be installed using approved "J" hooks or other approved open-top supports. The supports shall be spaced no further than five feet apart.

F. Use industry standard color codes and maintain consistent color-coding throughout the building.

G. All equipment, materials and devices listed and inferred shall be furnished and installed under this section unless noted otherwise.

1. Refer to the Drawings for locations and quantities.

2. Refer to Part 2 Products of this specification for additional information.

3.7 SLEEVING AND BUSHINGS

A. Raceways and openings shall be laid out in advance to permit their provision in the work. Sleeves and raceway shall be set before masonry is constructed. Any extra work required where sleeves or raceways have been omitted or improperly placed shall be performed at the expense of the Installer which made the error or omission, including coring.

B. Provide sleeves for raceways and cable trays penetrating floors, fire walls, or smoke partitions. Install approved material to provide for fire stop.

C. Provide waterproof seals inside and outside raceway when penetrating from the exterior or underground.

D. Except where specified otherwise sleeves shall be made of galvanized metal to finish flush with building finish lines.

E. Provide acoustic sealer in sleeves between occupied spaces.

F. Sleeves installed in floors shall extend two inches above the finished floor unless specifically indicated otherwise.

G. Provide sleeves in masonry construction and in full height (slab to slab) walls.

3.8 CABLE PROTECTION

A. Cables to be installed in existing enclosed open bays or furred spaces where conduit stubs are not provided, shall be protected from chafing or any damage. The Installer shall verify that the warranty shall not be violated before installing any cabling in these locations.

B. Provide bushings in all metal studs and other openings where cables will pass through. Bushings shall be of two (2) piece construction with one piece inserted through the openings and the second piece locking it into place. Single piece bushings with locking tabs or friction fit are specifically prohibited.

C. Provide cutting, coring, sleeves and bushings and seal as required at all penetrations.

D. Cables damaged during installation shall not be repaired. They shall be completely replaced with new cable.

3.9 DOCUMENTATION

A. Label all equipment as specified above

B. Provide the Owner with:

1. Hard copy documentation of "As-Built" A/V Systems Administration Reports.

2. "As-Built" drawings indicating location of all equipment including but not limited to work area outlets, patch panels, cross connect blocks, on each segment and cable routing. Indicate labeling for each piece of equipment.

3. Refer to Part One for additional documentation.

3.10 SYSTEM ACCEPTANCE

A. Obtain written acceptance from the Owner or their authorized representative for each cabling system installed on this project. Failure to obtain written acceptance shall result in delay of start of warranty period. No claim for additional costs will be allowed due to not receiving written acceptance. Warranty period will start upon receipt of written acceptance.

3.11 ACCEPTANCE DEMONSTRATIONS

A. Systems installed under this section shall be demonstrated to the Owner and Architect. Demonstrations are in addition to necessary testing and training sessions. Notify all parties at least 7 days prior to the scheduled demonstration. Schedule demonstrations in cooperation with and at times convenient to all parties and so as to not disturb ongoing activities.

B. Systems shall be tested prior to the demonstrations and each system shall be fully operational and tested prior to arranging the Acceptance Demonstration. Final payments will be withheld until a satisfactory demonstration is provided for all systems indicated or requested.

C. If the demonstration is not totally complete, performing all functions, features and connections or interfaces with other systems, or if there is a failure during the demonstration, additional demonstrations shall be arranged. Provide and pay for all costs, labor and expenses incurred for all attendees for each additional demonstration required for acceptance and demonstration of complete system operation.

D. Demonstrations shall be scheduled in ample time to complete all activities prior to final acceptance and Owner occupancy. Demonstrations shall take place at least 30 days prior to the scheduled project completion date and 30 days prior to owner's use and occupancy.

E. As a minimum, provide demonstrations for systems indicated under "Work Included" under Part One of the Specifications. Provide demonstrations of additional systems as requested by the Owner or Architect.

3.12 PROJECT OWNER COORDINATION

A. Prior to Substantial Completion of the project and in ample time to address and resolve any coordination issues, request and arrange meetings between the Owner, Owner's Vendors and Consultants, Architect, and General Contractor to discuss the Scope of Work for each system being provided and the interface required for a fully functional and operational system upon project completion. Initial meetings shall be scheduled three months prior to the scheduled Substantial Completion date or as soon as Submittals are submitted and reviewed for projects with shorter schedules.

B. At these meetings the required interface with the Owner shall be reviewed, requests for information required to complete programming or for coordination shall be presented and system operation and philosophy shall be discussed.

C. Additional meetings shall be held as requested by any party so that all issues are resolved and with the goal and intent being that all systems are fully operational and functional upon project Substantial Completion and that the responsibility for all components required is clearly established.

3.13 CLEANING UP

A. Upon completion of all work and testing, thoroughly inspect all exposed portions of installation and completely remove all exposed labels, markings, and foreign material.

B. The interior of all equipment and cabinets shall be left clean; exposed surfaces shall be cleaned and plated surfaces polished.

C. Repair damage to finish surfaces resulting from work under this section.

D. Remove material and equipment from areas of work and storage areas.

E. All equipment shall be clean from dirt, dust, and fingerprints prior to final acceptance.

F. Touch up all damaged pre-finished equipment using materials and methods recommended by the Manufacturer.

3.14 PROJECT CLOSEOUT

A. Provide close out submittals as required herein and in Division One including the following close out submittals.

1. Operation and Maintenance Manuals

2. Record Drawings.

3. Test Reports.

B. Obtain written receipts of acceptance close out submittals submitted. Receipts shall specifically detail what is being delivered (description, quantity and specification section) and shall be dated and signed by firm delivering materials and by the Owner's Representative.

1. Provide record drawings indicating actual cable routings and cable terminations and all required identifiers.

END OF SECTION 27 41 16

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SECURITY 280000 – SECURITY SYSTEMS

PART 1 - GENERAL

1.1 GENERAL

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS, which are hereby made a part of this Section.

B. The card access system have been designated as a “Proprietary Product” to match and integrate with the city’s system.

1.2 REFERENCE TO GENERAL CONDITIONS

A. The General Conditions shall be considered as forming an integral part of the specifications and shall be carefully examined before bid for any work submitted.

B. Definitions: In addition to the definitions outlined in the General Conditions, the following definitions shall apply to this Section of the Work:

1. Security System: The Security System shall consist of card access system, Intrusion Detection System (IDS) Access Control, and Equipment Racks (if required), all applicable wire and cable, and the functional integration of all subsystems through subsystem interfaces as specified herein.

1.3 SUMMARY

A. Scope of Work

1. The card access system basis of design is Avigilon Alta cloud-based ACS solution with the latest software, licensing, and mobile access at the time of installation.
   a. ACS System (panels, readers, software, power supplies)
   b. Front entrance shall include a video intercom with card reader capabilities.
   c. Security Contractor shall coordinate with door hardware for lock installation and integration.

2. The video surveillance system shall consist of new security cameras connected to the existing Avigilon Cloud Connector. New cameras shall be Avigilon Alta (H6SL-dome & H5A-multisensor) with all the latest software & licensing required to tie into the City of Providence existing VMS.
   a. Enterprise camera licenses based on the number of new cameras added to the existing system
   b. Mobile licenses
   c. Remote Server licenses

3. The Intrusion detection system shall be Honeywell 128 intrusion panel. This panel is for the motion sensors, door contacts, and panic buttons (if required) and will be set to 24 hour alarm to the police.

4. The Security contractor shall provide a fully integrated Security System and applicable wire and cable for this project.

5. The electrical contractor shall provide all back boxes, conduit, 120VAC power, and fire alarm relays as indicated on the security drawings.

6. The Security contractor shall provide coordination with security door hardware. Coordinate door hardware with the Architect and the hardware engineer. Refer to Division 8 for additional scope of work.

7. The Security contractor shall be responsible for providing complete and working systems.

8. All penetrations shall contain UL listed fire stopping as required by code which shall be installed by the security contractor or general contractor/construction manager.

9. All door hardware is by the division 8 contractor, wireless locks shall be provided by security contractor.

   All device cabling shall be routed to the termination points as shown on the security riser system drawing and part plans on where the security data gathering panels, transformers, and Power Supplies, etc. located therein. The Contractor shall provide copper cabling from the data gathering panels to the doors.

10. Related Work: The following items are not included in this Section and will be performed under the designated Sections. Security contractor to coordinate with the following. Refer to each trade construction documents for additional scope of work:

    a. Division 27 Sections – TELECOMMUNICATIONS
    b. Division 8 – OPENINGS
    c. Division 11 Sections – VEHCLE AND PEDESTRIAN EQUIPMENT
    d. Division 25 – INTEGRATED AUTOMATION
    e. Division 26 - -ELECTRICAL

B. REFERENCES: The security system shall be installed in accordance with all applicable national, state and local codes including but not limited to the most recent editions of the following:

1. National Fire Protection Association, 2015 (NFPA 70)

2. National Fire Protection Association Life Safety Code, 2015 (NFPA 101)

3. Building Officials & Code Administrators International, Inc. (BOCA) National Building Code

4. Americans with Disabilities Act (ADA)

5. Underwriters Laboratories (UL) Applicable Standards for Safety

6. Underwriters Laboratories (UL) Applicable Standards for Proprietary Security Systems

7. Uniform Building Code, 2015 (UBC)

8. Open network video interface forum (ONVIF) standards and compliance

9. International Building Code (IBC), 2015

10. ANSI/BICSI 005-2016 Electronic Safety and Security Design and Implementation

1.4 SUBMITTALS

A. General Description and Requirements

1. Submit Submittals in accordance with the construction schedule.

2. Submittals shall consist of Product Data Sheets with Part Numbers Highlighted, Shop Drawings which shall include Symbols Lists, Floor Plans, Security Room Part Plans, Wall Field Elevations, Equipment Rack elevations, Component Installation Details, and Detail Riser diagrams for each system, Samples as requested, all Required State Licenses for both the contracting corporation, and their employees, Manufacturer's Certifications (2 minimum) and a detailed completion schedule. Partial submittals will not be accepted.

3. No portion of the Work shall commence nor shall any equipment be procured until the Pre-fabrication Submittals have been approved.

4. Submittals shall be accompanied by a letter of transmittal identifying the name of the Project, Contractor's name, date submitted for review, and a list of items transmitted.

B. Samples

1. The Contractor shall submit samples of any equipment components upon request of the Architect.

C. Record Documentation

1. Prior to any final acceptance testing, submit one set of preliminary (draft) record drawings to the Architect. The preliminary record drawings are to be used by the Engineer to conduct the system final test.

2. Upon final acceptance of the work, the Contractor shall submit 3 Hard copies, and 1 soft copy of the record documentation within 30 days from the date of final acceptance to the Architect/Owner.

3. Record documentation shall include all information required in the submittals but revised to reflect as installed conditions. Record documentation shall include the following:

    a. Operation and maintenance manuals for all devices, equipment and software modules.

    b. Floor plan drawings indicating device locations with device legends indicating manufacturers and model numbers for each device.

    c. Floor plan drawings indicating conduit and wire routing and junction box locations. Wire routing shall include cable identification and terminal strip numbers.

    d. Mounting details for all equipment and hardware.

    e. Functional block diagrams for each system.

    f. Wiring details showing rack elevations, equipment wiring, terminations and inter-rack wiring.

    g. Wiring diagrams for all custom circuitry.

    h. Wiring diagrams for each Data Gathering Panel.

    i. Point to point wiring diagrams.

    j. Layout details for each riser location, including security panels, power supplies, junction boxes, conduit and any other security-related equipment located in the riser.

4. All record documents shall be supplied in both hard copy and in an electronic format as required by the Project at time of submittal.

5. Operation and Maintenance (O&M) Manuals

    a. Operation and Maintenance Manuals shall include, as a minimum, the following:

        1) Operational description of each subsystem.

2) Detailed programming descriptions for each subsystem, including step-by-step procedures with illustrations identifying how computer screens will appear after each entry.

3) Explanations of subsystem interrelationships. Explanations shall include operations of each subsystem and operations unique to the interfaces between each of the subsystems and possible conflicts that may occur with the interfaces. Each explanation shall be identified, tagged, bound and indexed into a single binder.

4) Electrical schematics for each piece of equipment specified.

5) Power-up and power-down procedures for each subsystem.

6) Description of all diagnostic procedures.

7) A menu tree for each subsystem. The tree shall provide a graphical flow of commands within the menu system.

8) Setup procedures for each component of the subsystems.

9) A list of manufacturers, their local representatives and Integrators that have performed Work on the Project. The list shall include contact names, phone numbers and addresses for each.

10) Installation and service manuals for each piece of equipment.

11) Maintenance schedules for all installed components. Schedules shall include inspections and preventative maintenance schedules, and documentation of all repaired or replaced equipment.

b. Operation and Maintenance Manuals shall include a separate section for each software program incorporated into the Project. The software section shall include, at a minimum, the following information:

1) Definitions of all software related terms and functions.

2) Description of required sequences.

3) Directory of all disk files.

4) Description of all communications protocols, including data formats, command characters, and a sample of each type of data transfer.

5) Instructions for manufacturer supplied report generation with illustrations showing what reports should look like and screen-by-screen illustrations for each entry made.

6) Instructions for custom report generation.

7) Database format and data entry requirements.

c. As a minimum training sessions shall consist of the following:

1) General project information and review shall be by the General Foreman or Superintendent of the Trade.

2) Specific system training shall be by a Factory Trained Representative.

3) Provide a complete review of the project and systems including, but not limited to, the following:

a) Note equipment layouts, locations and control points.

b) Review each system.

c) Review system design operation and philosophy.

d) Review areas served by equipment.

e) Identify color codes used.

f) Review features and special functions.

g) Review maintenance requirements.

h) Review operation and maintenance manuals.

i) Respond to questions

4) After classroom training, walk the entire project, review each equipment room and typical locations. Explain equipment and proper operation.

1.5 QUALITY ASSURANCE

A. Contractor Qualifications: The Bidder shall provide information in the proposal to demonstrate compliance with these requirements.

1. Work specified herein shall be the responsibility of a single electronic security systems integration contractor.

2. The security contractor shall have local in-house engineering and project management capabilities consistent with the requirements of the Work. The Contractor shall provide a team supervised by a full-time on-site foreman who is to be present at all times that Work is actively in progress. The Contractor shall provide a team managed by a full-time project manager who is to be present at all construction meetings and available to answer all questions by the Architect or the construction team.

3. By submitting a Bid, the Contractor thereby certifies that it is qualified in all areas pertaining to, either directly or indirectly, the Work. In the event the Contractor becomes unable to complete the Work in accordance with the Contract Documents, or the satisfaction of the Owner or its representatives, due to a lack of understanding of equipment, systems or services required by the Contract Documents, it shall be the responsibility of the Contractor to retain the services of the applicable manufacturers' representatives to expeditiously complete the Work in accordance with the construction schedule at no additional cost.

4. The Contractor shall maintain, or establish and maintain, a fully staffed local office including a service center capable of providing warranty and service to the Security System for the Project. The Contractor shall staff the service center with factory trained technicians and adequately equip the office to provide emergency service within 4 hours after being called, 24 hours per day, whether or not the Owner elects to purchase a maintenance contract from the Contractor.

5. The Contractor shall provide factory-certified technicians with the latest and most advanced training on the specified SMS/IDS software/hardware, workstations and data gathering panels. These certified employees shall provide the installation of, and commission of, the Work. All installing personnel shall also be licensed as required by local and/or state jurisdictions. The Contractor shall provide all licensing documentation as part of the submittal process.

6. The Contractor shall ensure compliance with, and have a thorough understanding of, all local codes and contract conditions pertaining to this Project.

7. The Security contractor shall maintain an inventory of spare parts in house and other items critical to system operation and as necessary to meet the emergency service requirements of this Project within the local service center. A current inventory list shall be provided for within the submittal. Spare parts shall include, but not be limited to, the following:

    a. SMS/VMS

        1) Data Gathering Panel (including all boards)

        2) Door controllers

        3) Input/Output boards

        4) Card readers

5) Video Intercom

6) Security cameras

7) Door position switches

8) Request-to-exit motion sensors

9) Power supplies

B. Product Standards

1. All materials (except those existing materials or materials provided by other Sections and specified for incorporation in the completed work) included in the completed security system installation shall be new, not refurbished and shall fully comply with the latest published specifications of the manufacturer.

2. Unless otherwise specified, all components included in the completed security system shall be standard, unmodified production models.

3. Equipment that is installed, maintained, serviced, programmed, etc. by a single representative due to proprietary equipment and/or manufacturer region exclusive agreements shall not be acceptable. All equipment proposed by the Contractor shall be available to at least, three dealer/installer representatives, minimum, within a 50 mile radius of the Project site.

4. All equipment, components and materials provided by the Contractor shall, in every respect, meet or exceed the performance characteristics and technical specifications for referenced components.

5. It shall be the responsibility of the Contractor to provide complete and detailed technical information for all equipment, components and materials. In the event that submitted technical information is not sufficient to permit the Engineer to readily confirm that proposed equipment, components and materials will meet or exceed the performance and technical specifications, the proposed equipment, components or materials shall be rejected. The Engineer shall determine the final decision as to whether proposed equipment, components and materials are acceptable. In no case shall acceptance by the Owner of proposed equipment, components and materials relieve the Contractor of his responsibility to produce completed systems, which comply with these specifications.

6. Within the technical specifications for the system, certain manufacturers may be specified. These manufacturers are listed for example purposes only.

7. Provide at the time of installation the latest version of all equipment and software.

8. The systems (including software, hardware and firmware) proposed for this project shall have been installed in at least five projects of similar size and nature and shall

have been in beneficial use for at least six months prior to submission of the bid proposal. Provide a compliance statement from each manufacturer along with references.

9. All exterior devices shall be sealed and protected against all weather conditions including heat, cold, moisture, dust, and sand.

10. As Part of the Submittal process, the Security Contractor shall provide unit pricing for all components, hourly labor rate for all parties involved in the project (foreman, installer, PM), and installation costs for each component. Assume a 300ft run for each. Installation cost shall be broken out by materials and labor.

1.6 WARRANTY

A. Provide a two-year warranty on the Work. If, within the two years after the date of final acceptance of the Work or within such longer period of time as may be prescribed by law, or by the terms of any applicable special warranty required by the Contract Documents or provided by a manufacturer, any of the Work or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such non-conforming condition. This obligation shall survive termination of the Contract. The Owner will give such notice promptly after discovery of the condition.

B. Nothing contained in the Contract Documents shall be construed to establish a shorter period of limitation with respect to any other obligation that the Contractor might have under the Law, the Contract Documents, or any manufacturer’s warranty. The establishment of the time period of one

C.

1. During the Warranty period, the Contractor shall, upon receipt of a request for service form the Owner, deploy service personnel to the Owner's premises within four hours (After hours time included) to initiate corrective action.

2. All Warranty service and repair work shall be performed by personnel who have been trained, certified and are experienced in the operation and maintenance of the installed system(s).

a. Warranty service shall include the replacement of all parts and/or components as required to restore normal system operation. In the event that system parts or components must be removed for repair, it shall be the responsibility of the Contractor to furnish and install temporary parts and/or components as required to restore normal system operation until the repaired parts or components can be repaired and re-installed.

b. It shall be the responsibility of the Contractor to maintain an inventory of spare parts or to arrange for manufacturer parts support as required to ensure correction of all critical component failures or malfunctions within 48 hours of the Owner's request for service. Critical parts shall be defined

as those, which govern or affect the normal operation of more than one field device.

c. The Contractor's Warranty obligation shall include correction of any software/firmware defects, which may be identified during the Warranty period. Any failure of the software/firmware to perform as specified by the software/firmware manufacturer at the time of final acceptance shall be defined as a software/firmware error.

d. In the event that the Contractor determines and demonstrates to the Owner's sole satisfaction that service or repairs are required as a result of misuse, abuse or abnormal wear and tear, the Contractor shall be compensated for such service or repairs as agreed upon by the Contractor and Owner. Similarly, such compensation to the Contractor shall apply in the event that repairs are required for devices and equipment not provided by the Contractor but incorporated in the completed systems.

e. Immediately following the completion of a Warranty repair or service call, the Contractor's service personnel shall submit a written report to the Owner which details the service work performed, the cause of the trouble, and any outstanding work which is required to restore complete and normal operation.

D. Perform preventative maintenance during the warranty period. Submit a list of items to be included in the preventative maintenance program in the submittal process. The list shall include maintenance to each item, the frequency of such maintenance, and the amount of time to be spent on each item for maintenance. Preventative maintenance shall include, but not be limited to, the following.

1. Annual Preventative Maintenance: Test and adjust system sensors.

2. Semi-Annual Preventive Maintenance

a. Inspect and clean all Data Gathering Panels.

b. Inspect, test, and clean power supplies. Replace batteries as necessary.

c. Inspect, clean and vacuum all equipment racks.

3. Quarterly Preventive Maintenance

a. Run SMS system diagnostics and perform file maintenance to insure optimal performance.

b. Provide Security System Software updates as required.

E. Include a manufacturer's software support agreement as part of the Warranty. This agreement shall include all software updates, revisions, telephone service assistance and training for any changes in operation.

F. Provide written notice to the Owner documenting any work performed during the warranty period, including any preventative maintenance work performed.

G. Provide loaner equipment for any equipment not field repairable. Such loaner equipment shall be in working order and the functional and technical equivalent of the item replaced.

H. Provide loaner equipment that is fully compatible and fully functions with all associated equipment.

I. Loaner equipment for system components (example: card readers, video intercom, etc.) that must be shipped from the manufacture or distributor shall be on site and operational within 48 hours of the component failure. Furnish lists of equipment that will require shipment from the manufacturer or distributor and lead times associated with that equipment.

J. Repair or Replacement Service

1. Repair or replacement service during the warranty period shall be performed in accordance with the following:

a. Major system components including, but not limited to, the SMS system workstations, data gathering panels (Data Gathering Panels): 7 days, 24 hour, 2 hour response time.

b. All other components and devices: 7 days, 24 hour, 4 hour response time.

K. If the Contractor is unable to restore system operation during the warranty period within one business day of a system failure, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.

L. The Owner reserves the right to expand or add to the system during the warranty period using firm(s) other than the Contractor for such expansion without affecting the Contractor’s responsibilities, provided that the expansion is done by a firm which is an authorized dealer or agent for the equipment or system being expanded.

M. Provide on-line software maintenance and support during the warranty period including all software and hardware updates for all provided equipment. It is up to the contractor to inform the building management about all updates during the warranty period.

PART 2 - PRODUCTS

2.1 SECURITY MONITORING SYSTEM (SMS)

A. System Architecture

1. General

a. The Security Monitoring System (SMS) consists of cloud based software, system workstations (by owner), printers (by owner), enrollment readers and card readers, Reader Boards, I/O Boards, and Intelligent IP controllers, provide new data gathering panels as indicated on the drawings.

b. The SMS workstations shall communicate with the owners SMS cloud system an Owner provided enterprise network. Interface with communications outlets located in the main telecommunications equipment room, and the security monitoring station. Configure the SMS workstation ancillary equipment. Coordinate with the Owner for naming conventions, IP address programming, and switch port connections to the network for all devices and panels

c. All SMS network devices shall synchronize their system time with the owner's network time source. SMS software shall not impede use of the NTP or SNTP protocols, MD5 authentication algorithm or the operating system's NET TIME command.

2.2 CLOUD-BASED ACCESS CONTROL SOFTWARE

A. Design: Avigilon Alta Access, by Motorola Solutions Inc.

B. Operating System: Cloud-based software hosted on AWS Cloud Services.

C. Access Control Software Capacities: Cloud-based storage supports unlimited users, groups, hardware, entries, schedules, rules, alerts, and alarm configurations.
1. Intelligent Controllers: Unlimited per appliance allowing geographic independence from appliance via IP communication.
2. Access Control System Appliances Supported: Unlimited.
3. Events Stored: Unlimited.
4. Sub-Panels: Unlimited.
5. Doors: Unlimited.
6. Time Schedules: Unlimited.
7. Identity and Operator Database: Unlimited.
8. Client Connections: Unlimited.
9. Rules: Unlimited.
10. Alarm Configurations: 100.
11. Open Alarms: 100.

2.3 CLOUD-BASED ACCESS CONTROL SOFTWARE ADMINISTRATION

A. Updates: Provide access control software capable of automatically updating the following:
   1. Administrative Software: Version, service packs, and security vulnerabilities.
   2. Field Devices: Firmware versions.

B. Upgrade Functionality: Provide access control software capable of automatically upgrading software licensing.

C. License Requests: Provide access control software capable of managing license and feature requests from customer accounts.

D. Multi-factor authentication in access control software:
   1. Provide ability for administrator to enforce MFA in users and roles.
   2. Provide ability for user to use a TOTP-compatible app for authentication.

2.4 CLOUD-BASED ACCESS CONTROL SOFTWARE INTERFACE

A. Web-Based Access Support: Provide access control software with browser-based access to system applications including support for industry-standard desktop and mobile web browsers.

B. Language Support: Provide software in English, German, French, Italian, or Spanish based on the browser locale or user preference.

C. Dark mode, light mode, and OS theme options for users.

D. Events and Alarms: Provide system that allows administrators to configure email and SMS alerts for the following:
   1. Entry and user events including forced entries, ajar entries, unlock failures, authentication failures, authorization failures, and/or anti-passback breaches.
   2. Hardware input and relay state changes.
   3. Identity provider synchronization.
   4. Billing: Payment due dates, expired Terms and Conditions, and/or when the account is frozen.
   5. Offline controllers and tamper alerts.
   6. Motion and sound detection.
   7. Occupancy limits reached.
   8. Low battery, tamper, and offline alerts for wireless locks.

E. Entry Schedules: Provide system that allows administrators the ability to create entry schedules and default entry states.

F. User Schedules: Provide system that allows administrators the ability to create user schedules and default entry states.

G. Identity Records: Provide a system with integrated identity management, allowing imports of data from supported integrations and via CSV upload. Each identity supports access control based on groups and roles as well as individual overrides. Provide identity records capable of management and synchronization between multiple sites. Create users, assign credentials, and define entry access.

1. All-access credentials for first responder use: Issue an all-access credential to access all entries in all zones in a site during emergency situations.

H. Custom Fields: Create custom user fields.

I. Roles: Support a role-based permission method allowing one or more roles to be assigned to identities to determine physical and logical access.

J. Custom Read/Writer Permissions: Create custom roles with granular read/write permissions for Administrators in the portal.

K. Anti-Passback: Provide access control software capable of designating areas to require a credential to enter and exit the area before it is used to enter the area again.
1. Soft and Hard Area APB: Tracks each credential that enters an area and defines which areas the badge may access next.

L. Physical Badging: Provide a tool to support the creation of custom badge layouts including the following content:
1. Static Information: Badge size, background color, text strings, and graphics common to every badge.
2. Dynamic Information: Text fields and images from the identities database unique to each badge.

M. Digital Badging: Provide a tool to support the creation of custom digital badge layouts for mobile credentials including the following content:
1. Static Information: Badge size, background color, text strings, and graphics common to every badge.
2. Dynamic Information: Text fields and images from the identities database unique to each badge.

N. Enrollment: Provide integrated identity management and enrollment functionality as part of the core system functionality.
1. Allegion Schlage credential enrollment readers: Automatically added by syncing the access control software with the commissioned ENGAGE site.

O. Rules Engine: Provide system capable of linking one or more events and conditions to rules that trigger actions and alerts. Create conditional rules that trigger specified actions based on entry events, input state changes, user activity, lockdown activity, identity provider issues, and hardware relay changes. Use GUI to create input-related or event forwarder rules, or use JSON to create custom rules for entry, reader, relay, and lockdown events.
1. Provide GUI for creating custom rules and workflows related to entry, reader, relay, and lockdown events.
2. Advanced event category.

P. Quick Start: Provide access control system that supports quick start configuration to automatically populate standard parameter fields in groups for new sites, readers, and controllers.

Q. Encryption: Provide access control system that supports the following encryption methods:
1. TLS 1.2+: Require TLS encryption between the access control system and Openpath controller.

2. Private key: Require mobile credential to utilize a revolving NSA Suite B cryptographic algorithm, with the private key to be generated on the mobile device and never to be shared, only to use public key pairing.

R. Dashboards: Monitor via real-time dashboards user activity, entry activity, and hardware states, including:
1. Access control panel cloud and LAN connection status, hardware version, and software version.
2. Credential reader connection status, hardware version, software version, and temperature.
3. Video footage, live event feed, and occupancy.
4. Badge verification, including badge photo, transaction time, and date.
5. Unlock entries from the main dashboard, provided the entries are configured to support remote unlock.
6. Identify hardware by activating the lights on the specified access control panel and indicator lights and buzzer on the specified credential reader for troubleshooting purposes.
7. Create custom dashboards to monitor entry activity, cameras, occupancy, statistics, and lockdown plans.

S. Reporting: Generate, filter, edit, and customize system reports that can be exported to CSV format. Support the following report types:
1. Activity logs. Can be scheduled on a recurring basis.
2. User activity.
3. Entry activity.
4. Visual activity.
5. Entry access audit.
6. User access audit.
7. Portal audit report.
8. Operator audit trail.
9. Credential management.
10. Alarm Management.
11. Mustering.
12. Offline wireless lock events are shown only in Activity logs, Alarms, Entry activity, and User activity reports, after performing a manual sync with the locks.

T. Lockdown Plans: Define, trigger, and revert lockdown plans. Alert local authorities with video when a lockdown plan is triggered.

U. Landlord/Tenant Support: Share zones with other organizations to support landlord/tenant scenarios.

V. Hardware Configuration: Add access control panels, credential readers, credential enrollment readers for wireless locks, intercom readers, and wireless locks.
1. View wireless lock gateways synced using the Allegion ENGAGE™ app. Sync gateways and update firmware in the dashboard.Integrations: Support third-party integrations, including identity providers and other applications, natively as well as through custom configurations and Zapier. Create custom integrations with webhooks.

W. Portal SSO: Support SSO, allowing Administrators to authenticate via identity providers including, but not limited to, Microsoft Azure Active Directory (OAuth2 and OAuth Client

Service Principal authentication), Google G Suite, Okta (OAuth 2.0 authentication), and OneLogin integrations.

X. Mobile App SSO: Support SSO, allowing users to authenticate their mobile credentials via Okta integration.

Y. Partner Support: Partner Center provides overview of customer accounts, hardware, and software license requests. Manage accounts, access the store, and access marketing and training materials.

Z. Video Intercom: Initiate and answer one-way video, two-way audio calls, remotely unlock entries from the voice assistant interface, and set up voicemail and call routing to users, groups, or units. Generate a QR code for directory lookup on mobile phones. Includes support for legacy SIP mode for VoIP calling.
   1. Building management: Create floors, units on a floor, and assign to users and groups.

2.5 CLOUD-BASED ACCESS CONTROL SOFTWARE INTEGRATIONS

A. Subscription-based software licenses for integrators.
   1. Identity Management and HR Systems.
      a. Data sync every hour.
      b. Data sync every 15 minutes.
   2. Workplace Communications.
   3. Event Monitoring Software.
   4. Visitor Management.
   5. Middleware.
   6. Video Management.
   7. Printing Badges on Card Printers.
   8. Tenant Experience.
   9. Spatial Awareness.
   10. Emergency Notification and Response.
   11. Coworking / Flexible Workspace.
   12. Building Management Systems.
   13. Video Analytics.
   14. Gym and Fitness.
   15. Parking Solutions.
   16. Schlage Wireless locks.
   17. Video Integrations: Coordinate integration and unification requirements with section 28 05 45.
      a. Avigilon Alta Aware: When activated for an organization within Alta Control Center, a unified user password is employed for seamless integration across both systems.
      b. Camio.
      c. Cisco Meraki.
      d. Milestone.
      e. Rhombus Systems.

2.6 CLOUD-BASED ACCESS CONTROL HARDWARE INTEGRATIONS

A. Panel Hardware:
   1. Avigilon Access Control Core Controller.

2. Avigilon Single Door Controller.
3. Avigilon 4 Port Board.
4. Avigilon 8 Port Board.
5. Avigilon 16 I/O Elevator Board.
6. Legacy hardware using passthrough.

B. Supported Reader Hardware:
1. Avigilon Standard Smart Reader.
2. Avigilon Mullion Smart Reader.
3. Avigilon Standard Smart Keypad Reader.
4. Avigilon Mullion Smart Keypad Reader.
5. Avigilon Embedded USB Smart Reader.
6. Avigilon Video Reader Pro.
7. Avigilon Video Intercom Reader Pro.
8. Legacy Wiegand-based Readers using passthrough.

C. Credential Technologies:
1. Avigilon Alta (formerly Openpath) Mobile Credential.
2. Avigilon Alta Cloud Key and Guest Pass.
3. Avigilon Alta 13.56 MHz DESfire (EV1, EV2, and EV3) Credentials.
4. Avigilon Alta 125 kHz LF Prox.
5. Provide Openpath Custom DESFire Configuration Card to maintain backward compatibility of EV3-A DESFire cards and forward compatibility of EV3-B cards with readers.
6. Schlage: All Physical (Mifare, Prox, DESFire).
7. Farpointe Data: All Physical (Mifare, Prox).
8. Other non-proprietary card formats (Mifare, Prox).

D. Credential Enrollment Readers for programming Allegion Schlage keycards and fobs.
1. Up to 11 entries are supported on each keycard or fob.

E. Wireless Locksets:
1. Allegion Schlage: NDEB, LEB, and Control™ wireless locksets.

F. Exit Devices:
1. Von Duprin. RU & RM.

G. Supported Camera Hardware:
1. Avigilon Ava cameras connected through Alta Aware user account.

H. Power Supplies: Provide one of the following power supplies that are manufacturer-prepared to support Avigilon hardware.
1. LifeSafety Power: Enclosures, Kits, and Power Supplies.
2. Backup battery (not included): 12VDC sealed lead acid (SLA) or gel cell batteries in series.

I. Request-to-Exit Devices

a. Request To Exit (REX) Motion Sensors

1) Provide REX motion sensors for detecting authorized exits through card reader controlled doors as indicated on the Security Device Drawings.

2) Wire the REX motion sensor to the manufacturer's recommended input of the Data Gathering Panel or door controller. Also Rex shall be wired for 4-state Supervision and report circuit shorted, switch closed, switch open, open circuit.

3) For doors equipped with electromagnetic locks, activation of the REX motion sensor shall release the electric locking mechanism and shall shunt the intrusion alarm output.

4) For doors equipped with electric locking mechanisms that are free exiting at all times (e.g. mortise electric locks, electric strikes, etc.), the REX motion sensor shall only shunt the intrusion alarm output and shall not unlock the lock. Use of door control buttons and graphics shall not affect the request to exit motion sensor operation for doors with free egress hardware.

5) REX motion sensors shall be labeled to meet local codes.

6) REX Motion Sensor must be dual technology, and be line of sight adjustable.

7) Refer to Division 8 construction documents, and security drawings for locations.

8) Acceptable Manufacturers:

a) Bosch DS160
b) Tyco T.Rex-LT-NL

b. Request-to-Exit Pushbutton

1) Provide a UL Listed request-to-exit (REX) pushbuttons as indicated on the Security Device Drawings for unlocking card reader controlled doors with electromagnetic locks, and as required.

2) Wire the REX pushbuttons to the REX input of the associated Data Gathering Panel or door controller. Activation of the REX pushbutton shall release the lock and shall shunt the door alarm.

3) The REX pushbutton shall contain an adjustable time delay relay for door unlock and shall be intrinsically fail-safe in order to release the door(s) in the event of a failure of the exit control circuitry within the Data Gathering Panel. It shall also be pneumatic, and require no additional power.

4) Refer to Division 8 construction documents, and security drawings for locations.

5) Acceptable Manufacturers:

a) Dortronics W5286-P23DAXE1
b) Or approved equal

c. Electric Locking Mechanisms

1) Refer to Division 8 construction Documents for required electric locking types. All door hardware is specified by Division 8.

2) Electric locks to be provided and installed by division 8 contractor.

3) Electrical Contractor to provide 120VAC power local, and Fire relay each door as indicated in the construction documents.

4) Security contractor to provide cabling and make final connections to electric locking mechanisms and power transfer devices provided by the hardware contractor as indicated on the Security Device Drawings.

5) Provide fail-safe operation of electric locking mechanisms as required by local codes.

6) Provide cabling from device to power supplies for all electric locking mechanisms. Fail-safe locking devices shall unlock automatically under the following conditions:

7) Any building fire alarm

8) Loss of building power

9) Failure of the power supply

7) Fail-secure locks shall remain operational during a fire alarm condition or power failure.

d. Automatic openers

1) Refer to Division 8 construction documents for required locations, and types.

2) Electrical Contractor to provide 120VAC for all auto openers.

3) Auto openers to be provided and installed by division 8 contractor.

4) Security contractor to provide cabling and make final connections to the auto openers, and interface with the access control system as indicated on the Security Device Drawings.

e. Power Supplies

1) Provide power supplies for all SMS equipment, Data Gathering Panels, as specified herein.

2) Provide independent, fused outputs for each device connected to the power supply.

3) For Locks, provide a multi-output access power controller with independent fused relay outputs and Fire Relay interface.

a) All power supplies to contain two 12AH batteries for backup.

4) Monitor power fail alarms for each location within the SMS.

a) All 12/24VDC Power Supplies must be UL listed.

5) All 120VAC for 12/24DVC power supplies must be wired directly in the enclosure in order to maintain UL listing. Refer to manufacturer's guidelines.

6) Refer to Division 8 construction documents for lock power requirements.

7) Acceptable Manufacturers:

a) Altronix
b) LifeSafety Power

f. Magnetic contact (door position switches):

1) Provide Double Pull Double Throw position switch to monitor the open/closed status of doors as indicated on the Security Device Drawings.

2) Magnetic contact (door position switches): Provide normally closed door position switches to monitor the open/closed status of doors and for camera callup whether the callup is for a door held open, door forced or the camera activation when a door is closed and the contact is made.

3) Acceptable Manufacturers:

a) GRI
b) Or approved equal

g. Tamper Switches

1) Provide normally closed tamper switches to monitor the secure status of all Security and power related enclosures

2) Include the number of tamper switches in the total alarm input figures.

3) Acceptable Manufacturers:

a) Bosch
b) Or approved Equal

h. Fire Alarm System

1) Electrical Contractor to Monitor normally closed fire alarm contacts from the Fire Alarm System.

2) Electrical Contractor to provide all required fire alarm relays at each Security head end location and as required by the division 8 construction documents and security drawings.

3) Security Contractor to Interface with a normally closed contact from the Fire Alarm Relay to the door power supply. This is to provide for automatic unlocking of fail-safe locks during a fire alarm.

4) Security Contractor to provide UL Listed Fire Alarm interface at each lock power location.

5) Security Contractor to provide all cable and connections as required to interface the terminals with the SMS and fail-safe locks. The Fire Alarm System Contractor will provide cable and connections as required from the interface terminal cabinet to the Fire Alarm System.

i. Data Gathering Panel Power Supply

1) The Data Gathering Panel power supply shall be dedicated to Data Gathering Panels and shall not provide power for locks or any other low voltage device.

j. Minimum Specifications:

1)	Type	UL Listed Class II power limited
2)	Input	120 VAC hard wired
3)	Output	Regulated and filtered DC
4)	Alarm outputs	Individual low battery and power fail
5)	Battery backup	Four hours of rechargeable backup for the connected load
6)	Battery support	Battery charger to maintain battery
7)	Battery	Sealed gel type
8)	Enclosure	Key lockable wall mount housing with tamper switch

k. The Data Gathering Panel Power Supply shall be housed in a locking steel enclosure designed for surface mounting. The housing shall include a tamper switch to sense the removal or opening of the enclosure cover. All Data Gathering Panel power supplies shall be keyed alike and shall be on the same key as all security system Data Gathering Panels, power supplies and power distribution cabinets.

l. Acceptable Manufacturers: As per the SMS manufacturer's recommendations and/or specifications.

m. Tamper Switch

1) Minimum Specifications:

2)	Type	Plunger
3)	Configuration	Normally closed when the cabinet door is closed
4)	Mounting	Fastened within cabinet with no access to fasteners when cabinet is closed

n. Request-To-Exit Motion Sensor. Provide request-to-exit motion sensors as indicated on the security drawings.

1) Minimum Specifications:

2)	Detection technology	Passive Infrared
3)	Detection pattern	Adjustable to provide coverage of immediate door area.
4)	Output contact	Normally open contact that closes momentarily (one second or less) when sensor is activated
5)	Power requirements	12-24 VDC
6)	Mounting	Surface mount to wall or ceiling or integral to the latching hardware.

o. Provide a manufacturer recommended power supply. The power supply shall be UL Class II, power limited.

p. Concealed Magnetic Contact (Door Position Switch). Provide concealed magnetic contact switches as indicated on the security device drawings.

1) Minimum Specifications:

2)	Gap	1/2 inch between the magnet and switch
3)	Configuration	DPDT Contact, White in Color.

4)	Security	Biased
5)	Mounting	As recommended by the door position switch manufacturer

2.7 CONTROL DEVICES

A. Single Door Controller:
1. Basis of Design Product: Avigilon OP-CR-SDC Single Door Controller.
   a. System Certifications:
   b. CE 60529 certification mark for Europe.
   c. IC certification mark for Canada.
   d. FCC Part 15 certification for The United States.
   e. NOM certification mark for Mexico.
   f. RCM certification mark for Australia and New Zealand.
   g. UKCA certification mark for the United Kingdom.
   h. ANATEL certification for Brazil.
   i. UL 294:
      Attack Level I.
      Endurance Level I.
      Line Security Level I.
      Standby Power Level I.
2. Unit Dimensions (LxWxD): 144.9 by 144.9 by 44.5 mm (5.71 by 5.71 by 1.75 in.).
3. Mounting: [Direct wall mount] [Single gang box] [Double gang box].
4. Capacity: Unit accommodates the following:
   a. Up to 2 entries and 2 Avigilon Smart Readers.
   b. Up to 2 Wiegand readers.
   c. Up to 2 relays, 2A at 24VDC (resistive).
   d. Communication Ports: 10/100 baseT Ethernet; 2 USB ports for readers.
5. Sensors:
   a. 2 REX Sensors, nominal 5VDC, 1kohm to each input (resistors built into Controller).
   b. Contact Sensors, nominal 5VDC, 1kohm to each input (resistors built into Controller).
6. Tamper Detection: Tamper sensor detects tamper events when front cover is removed.
7. Wi-Fi Enabled: Supports 2.4 GHz and 5 GHz connections.
8. Wiring: Standard RS-485 signaling to communicate with readers over standard wiring Includes removable contact terminal blocks for convenient wiring Physical switches to select relays to be dry or wet (12VDC or 24VDC).
9. Electrical Requirements:
   a. Supply Requirements: PoE, PoE+, or external 12 to 24VDC.
      When using an external supply, if 24VDC wet relay output is required a 24V external supply must be used.
   b. External Supply Requirements: 12V at 2A minimum or 24V at 1A min.
   c. Output Ratings:

Power Out can supply up to 100mA at 12V or 50mA at 24V.
2 reader ports, max power output: 250mA at 12V each.
2 relays, max power output:
PoE: Max 3W combined output (250mA at 12V, 125mA at 24V).
PoE+: Max 9W combined output (750mA at 12V, 375mA at 24V).

d. Battery Backup: May be added to PoE injector or optional external supply.

B. Access Control Core:
1. Basis of Design Product: Avigilon OP-CR-ACC Access Control Core.
2. System Certifications:
   a. CE 60529 certification mark for Europe.
   b. IC certification mark for Canada.
   c. FCC Part 15 certification for the United States.
   d. RoHS certification for Europe.
   e. UKCA certification mark for the United Kingdom.
   f. ANATEL certification for Brazil.
   g. RCM certification mark for Australia and New Zealand.
3. Unit Dimensions (LxWxD): 89.1 by 64.8 by 22 mm (3.51 by 2.55 by 0.87 in.).
4. Capacity: Unit accommodates the following:
   a. Up to 8 entries: 2 Avigilon 4-Port Expansion Boards.
   b. Up to 12 entries 1 Avigilon 4-Port Expansion Board and 1 Avigilon 8-Port Expansion Board.
   c. Up to 16 entries 2 Avigilon 8-Port Expansion Boards.
   d. Up to 8 entries: 1 HID (R) Mercury (TM) LP Series Intelligent Controller - LP1501.
   e. Up to 32 entries: 1 HID Mercury LP Series Intelligent Controller, LP1502 or LP2500.
5. Communication Ports 10/100/1000 baseT Ethernet 2 USB 2.0 ports and 2 USB 3.0 ports for expansion board connections.
6. Tamper Detection: Connects to tamper switch to detect opening of enclosure.
7. Alta Hardware: Mercury Security hardware.
8. Electrical Requirements:
   a. Input Voltage: 12 to 24VDC, 0.4A at 12V, 0.2A at 24V.
   b. Operating Voltage:12 to 24 VDC.
   c. Operating Current:
      0.7A at 12VDC.
      0.4A at 24VDC.
   d. Battery Backup: CR2032 3V, to be replaced every two years.

C. 4-Door Smart Hub:
1. Basis of Design Product: Avigilon SYS-4ENT-DVE1 12/24V 4-Door Core Series Smart Hub.
2. System Certifications:
   a. CE 60529 certification mark for Europe.
   b. IC certification mark for Canada.
   c. FCC Part 15 certification for the United States.
   d. NOM certification mark for Mexico.
   e. RoHS certification for Europe.
   f. UKCA certification mark for the United Kingdom.

g. ANATEL certification for Brazil.
h. UL 294:
Attack Level I.
Endurance Level I.
Line Security Level I.
Standby Power Level I.

3. Unit Dimensions (LxWxD): 308 by 355.6 by 119.9 mm (12.13 by 14 by 4.72 inches).
4. Capacity: Unit accommodates the following:
a. Up to 4 Avigilon Smart Readers.
Standard RS-485 signaling to communicate with Avigilon readers over standard wiring.
b. Up to 4 door relays, 5A at 24VDC (resistive).
c. Auxiliary Relays: 2 auxiliary relays and 4 configurable auxiliary I/O pins provide extra inputs and outputs and allow additional sensors or Wiegand devices.
d. Communication Ports: 10/100/1000 baseT Ethernet; USB port.
5. REX and Contact Sensors: 4 REX and 4 contact sensor inputs with end-of-line monitoring, nominal 5VDC, 1kohm to each input.
6. Wiring: RS-485 wiring to connect to the Avigilon Smart Readers. End-of-line monitoring with single or double termination on all REX, Contact, and Auxiliary inputs supported with user-installed 1k resistors.

7. Electrical Requirements:
a. Input Voltage: 120VAC, 208/230VAC with cuttable jumper.
b. Output Voltage: 12VDC and 24VDC.
c. Operating Current:
2.2A at 12V with 4 Avigilon Smart Readers.
1.2A at 24V with 4 Avigilon Smart Readers.
d. Locking Hardware Operating Current:
12V-only system: 1.8A.
24V-only system: 1.8A.
e. Power Supply: LifeSafety Power® E1 enclosure pre-installed with 24V FPV4 power supply, C4 relay-based lock control module, and B100 secondary voltage module.
f. Functions: 24V, 3A 1.7A at 24VDC or 3A at 12VDC available for locking hardware.
g. Battery Backup: Accommodates two 12VDC sealed lead acid (SLA) or gel cell batteries in series (not included).

D. 8-Door Smart Hub:
1. Basis of Design Product: Avigilon SYS-8ENT-DVE2 12/24V 8-Door Smart Hub – E2 Enclosure.
2. System Certifications:
a. CE 60529 certification mark for Europe.
b. IC certification mark for Canada.
c. FCC Part 15 certification for the United States.
d. NOM certification mark for Mexico.
e. RCM Certification mark for Australia and New Zealand.
f. RoHS certification for Europe.

g. UKCA certification mark for the United Kingdom.
h. UL 294:
Attack Level I.
Endurance Level I.
Line Security Level I.
Standby Power Level I.
i. CAN/ULC 60839-11-1.

3. Unit Dimensions (LxWxD): 406.4 by 508 by 119.9 mm (16 by 20 by 4.72 in).
4. Capacity: Unit accommodates the following:
a. Door Relays: 8 relays, 5A at 24VDC (resistive).
b. Avigilon Readers: Up to 8 Avigilon Smart Readers.
Uses industry standard RS-485 signaling to communicate with Avigilon readers over standard wiring.
c. Auxiliary Relays: 4 relays, 1A at 24VDC, 4 auxiliary relays, and 4 configurable auxiliary I/O pins provide extra inputs and outputs and allow additional sensors or Wiegand devices.
d. Door Relays: 8 relays, 5A at 24VDC (resistive).
e. Communication Ports 10/100/1000 baseT Ethernet; USB port.
f. REX and Contact Sensors 8 REX and 8 contact sensor inputs with EOL monitoring, nominal 5VDC, 1kohm to each input.
g. Auxiliary I/O: 4 input/output lines with EOL monitoring.
5. Wiring: RS-485 wiring to connect to the Avigilon Smart Readers. EOL monitoring with single or double termination on all REX, Contact, and Auxiliary inputs supported with user-installed 1k resistors.
6. Electrical Requirements:
a. Input Voltage: 120VAC, 208/230VAC with cuttable jumper.
b. Input Current: 3.7 Amp maximum.
c. Output Voltage: 12VDC and 24VDC.
d. Operating Voltage:12 to 24 VDC.
e. Operating Current:
3.3A at 12VDC with 8 Avigilon Smart Readers.
1.7A at 24VDC with 8 Avigilon Smart Readers.
f. g. Locking Hardware Operating Current:
12V-only system: 2.7A.
24V-only system: 4.3A.
h. Power Supply: LifeSafety Power® E2 enclosure pre-installed with 24V FPV6 Power Supply, C8 Relay Based Lock Control Module, and B100 Secondary Voltage Module. Up to 2A at 12V and 3A at 24V available for locking hardware.
i. Battery Backup: Accommodates two 12VDC sealed lead acid (SLA) or gel cell batteries in series (not included).

E. 8-Door Large Smart Hub:
1. Basis of Design Product: Avigilon SYS-8ENT-DVE4 12/24V 8-Door Large Smart Hub, E4 Enclosure.
2. System Certifications:
a. CE 60529 certification mark for Europe.
b. IC certification mark for Canada.
c. FCC Part 15 certification for the United States.

d. NOM certification mark for Mexico.
e. RoHS certification for Europe.
f. UKCA certification mark for the United Kingdom.
g. UL 294.
Attack Level I.
Endurance Level I.
Line Security Level I.
Standby Power Level I.
h. CAN/ULC 60839-11-1.

3. Unit Dimensions (LxWxD): 508 by 609.6 by 170.7 mm (20 by 24 by 6.72 in).
4. Capacity: Unit accommodates the following:
a. Door Relays: 8 relays, 5A at 24VDC (resistive).
b. Avigilon Readers: Up to 8 Avigilon Smart Readers.
Uses industry standard RS-485 signaling to communicate with Avigilon readers over standard wiring.
c. Auxiliary Relays: 4 relays, 1A at 24VDC 4 auxiliary relays and 4 configurable auxiliary I/O pins provide extra inputs and outputs, and allow more sensors or Wiegand devices.
d. Communication Ports 10/100/1000 baseT Ethernet; USB port.
e. REX and Contact Sensors 8 REX and 8 contact sensor inputs with EOL monitoring, nominal 5VDC, 1kohm to each input.
5. Wiring: RS-485 wiring to connect to the Avigilon Smart Readers. EOL monitoring with single or double termination on all REX, Contact, and Auxiliary inputs supported with user-installed 1k resistors.
6. Electrical Requirements:
a. Input Voltage: 120/230 VAC 50/60 Hz.
b. Operating Voltage: 12 to 24 VDC.
c. Operating Current:
3.3A at 12VDC with 8 Avigilon Smart Readers.
1.7A at 24VDC with 8 Avigilon Smart Readers.
d. Locking Hardware Operating Current:
12V-only system: 8.7A.
24V-only system: 4.3A.
e. Power Supply: LifeSafety Power® E4 enclosure pre-installed with 24V FP0150 Power Supply, B100 Secondary Power Module, C8 Lock Control Module, and D8P Power Distribution Module.
f. Battery Backup: Accommodates two 12VDC sealed lead acid (SLA) or gel cell batteries in series (not included).

F. 16-Door Large Smart Hub:
1. Basis of Design Product: Avigilon SYS-16ENT-DVE6 12/24V 16-Door Large Smart Hub, E6 Enclosure.
2. System Certifications:
a. CE 60529 certification mark for Europe.
b. IC certification mark for Canada.
c. FCC Part 15 certification for the United States.
d. NOM certification mark for Mexico.
e. RCM certification mark for Australia and New Zealand.
f. RoHS certification for Europe.

g. UKCA certification mark for the United Kingdom.
h. UL 294.
Attack Level I.
Endurance Level I.
Line Security Level I.
Standby Power Level I.
i. CAN/ULC 60839-11-1.
3. Unit Dimensions (LxWxD): 584.2 by 762 by 170.7 mm (23 by 30 by 6.72 inches).
4. Capacity: Unit accommodates the following:
a. Door Relays: 16 relays, 5A at 24VDC (resistive).
b. Avigilon Readers: Up to 16 Avigilon Smart Readers.
Uses industry standard RS-485 signaling to communicate with Avigilon readers over standard wiring.
c. Auxiliary Relays: 8 relays, 1A at 24VDC. 8 auxiliary relays and 8 configurable auxiliary I/O pins provide extra inputs and outputs, and allow more sensors or Wiegand devices.
d. Communication Ports 10/100/1000 baseT Ethernet; USB port.
e. REX and Contact Sensors 16 REX and 16 contact sensor inputs with EOL monitoring, nominal 5VDC, 1kohm to each input.
5. Wiring: RS-485 wiring to connect to the Avigilon Smart Readers. EOL monitoring with single or double termination on all REX, Contact, and Auxiliary inputs supported with user-installed 1k resistors.
6. Electrical Requirements:
a. Input Voltage: 120/230 VAC 50/60 Hz.
b. Operating Voltage:12 to 24 VDC.
c. Operating Current:
5.9A at 12VDC with 16 Avigilon Smart Readers.
3.2A at 24VDC with 16 Avigilon Smart Readers.
d. Locking Hardware Operating Current:
12V-only system: 26A.
24V-only system: 12.8A.
e. Power Supply: LifeSafety Power® E6 enclosure pre-installed with 24V FP0250 Power Supply, 12V or 24V FP0150 Power Supply, two C8 Lock Control Modules, and two D8P Power Distribution Modules.
f. Battery Backup:
For 24V supply, use two 12VDC sealed lead acid (SLA) or gel cell batteries in series (not included).
For 12V supply, use one 12VDC SLA battery (not included).

2.8 ACCESS CONTROL EXPANSION BOARDS

A. 4-Port Expansion Board:
1. Basis of Design: Avigilon OP-EX-4E 4-Port Expansion Board.
2. System Certifications:
a. CE 60529 certification mark for Europe.
b. IC certification mark for Canada.
c. FCC Part 15 certification for the United States.
d. RCM certification mark for Australia and New Zealand.
e. UKCA certification mark for the United Kingdom.

f. UL 294.

3. Unit Dimensions (Device Only) (LxW): 120 by 125 mm (4.72 by 4.92 in.)
4. Capacity: Unit accommodates the following:
   a. Readers: Up to 4 Avigilon Readers
   b. Relays: Up to 4 relays, 5A at 24VDC (resistive)
   c. Auxiliary Relays: 2 relays, 1A at 24VDC.
   d. REX and Contact Sensors: 4 REX and 4 contact sensor inputs: nominal 5VDC, 1 kohm to each input.
   e. Auxiliary Inputs: 4 input lines with EOL monitoring.
5. Interface Ports: USB port, Expansion port.
6. Wiring: Industry standard RS-485 signaling to communicate with Avigilon readers over CAT 5/6 wiring.
7. Electrical Requirements:
   a. Operating Voltage:12 to 24 VDC.
   b. Operating Current: 0.5A at 12VDC; 0.3A at 24VDC.
   c. Battery Backup: One or two 12VDC sealed lead acid (SLA) or gel cell batteries (not included) based on power supply and system requirements.

B. 8-Port Expansion Board:
1. Basis of Design: Avigilon OP-EX-8E 8-Port Expansion Board.
2. System Certifications:
   a. CE 60529 certification mark for Europe.
   b. IC certification mark for Canada.
   c. FCC Part 15 certification for the United States.
   d. RCM certification mark for Australia and New Zealand.
   e. UKCA certification mark for the United Kingdom.
   f. UL 294.
      Attack Level I.
      Endurance Level I.
      Line Security Level I.
      Standby Power Level I.
3. Unit Dimensions (LxW): (120 by 206 mm (4.72 by 8.11 in.)
4. Capacity: Unit accommodates the following:
   a. Readers: Up to 8 Avigilon Readers.
   b. Relays: Up to 8 door relays, 5A at 24VDC (resistive).
   c. Auxiliary Relays: 4 relays, 1A at 24VDC.
   d. REX and Contact Sensors: 8 REX and 8 contact sensor inputs with EOL monitoring, nominal 5VDC, 1kohm to each input.
   e. Auxiliary Inputs: 4 input lines with EOL monitoring.
5. Interface Ports: USB port, Expansion port.
6. Wiring: Industry standard RS-485 signaling to communicate with Avigilon readers over CAT 5/6 wiring.
7. Electrical Requirements:
   a. Operating Voltage:12 to 24 VDC.
   b. Operating Current:
      0.6A at 12VDC.
      0.3A at 24VDC.
   c. Battery Backup: One or two 12VDC sealed lead acid (SLA) or gel cell batteries (not included) based on power supply and system requirements.

C. 16-Capacity Elevator Board:
   1. Basis of Design: Avigilon OP-16EM 16 I/O Elevator Board.
   2. Certifications:
      a. CE 60529 certification mark for Europe.
      b. IC certification mark for Canada.
      c. FCC Part 15 certification for the United States.
      d. UL 294.
         Attack Level I.
         Endurance Level I.
         Line Security Level I.
         Standby Power Level I.
   3. Unit Dimensions (LxW): 133 by 90 mm (5.25 by 3.55 in.)
   4. Capacity: Unit accommodates the following:
      a. Readers: Up to 2 Avigilon Readers.
      b. Relays: Up to 16 relays, 60VDC Max:
         24VDC, 1A (resistive).
         125VAC, 0.5A (resistive).
      c. General Purpose Inputs: 16, 3V-24VDC.
   5. Interface Ports: USB port, Expansion port.
   6. Wiring: Industry standard RS-485 signaling to communicate with Avigilon Readers over traditional Wiegand wiring.
   7. Electrical Requirements:
      a. Operating Voltage: 12 to 24VDC.
      b. Operating Current:
         12V: 825mA Max (with 2 Avigilon Readers).
         12V: 325mA Max (with no readers).
         24V: 470mA Max (with 2 Avigilon Readers).
         24V: 190mA Max (with no readers).
      c. Battery Backup: NA.

D. Access Control Hardware Integrations:
   1. Supported Panel Hardware: Coordinate integration requirements with Section 28 13 00.
      a. Mercury Controllers: Series 3 (LP1501, LP1502, LP2500).
      b. Mercury Sub Panels: Series 3 (MR50-S3(B), MR52-S3(B), MR16IN, MR16OUT).

2.9 CLOUD-BASED ACCESS CONTROL MOBILE APPLICATIONS

A. Encryption: Support mobile credentials via a mobile app with end-to-end encryption to administrative portal.

B. Mobile app shall run in the background on a device with minimal battery usage.

C. Devices Supported: Mobile devices with Android and IOS operating systems, including Apple Watch.

D. Mobile app security:

1. Mobile credentials shall be assigned individually or as part of an identity provider integration.
2. Mobile credential to utilize a revolving NSA Suite B cryptographic algorithm, with the private key to be generated on the mobile device and never to be shared, only to use public key pairing.
3. All communication for access control to use TLS1.2+ encryption.
4. Mobile credential authentication shall use triple communication pathway: From mobile credential to reader over BLE, to panel over LAN Wi-Fi, to cloud and panel over Wi-Fi and LTE.
5. Mobile credentials to be authenticated via Bluetooth, NFC, and/or geoproximity.

E. Functions Supported:
1. Touch entry.
2. Wave to unlock.
3. In-app unlock.
4. Auto proximity unlock
5. Remote unlock.
6. Last-to-leave locking, allowing users to lock an entrance regardless of schedule.
7. 24-hour activity log.
8. Send emails to the site's help contact for troubleshooting when users are unable to access an entry.
9. Share guest access link.
10. Mobile credentials shall support custom virtual identification badges.
11. Call, email, and send audit logs to technical support from the mobile credential.
12. Trigger and revert lockdown plans from the mobile credential.
13. Detect nearby readers based on RSSI strength.
14. Reprovision mobile credential on a new or different device.
15. Touchless elevator access control.
16. Search for entries on list view.
17. Favorite entries list.
18. Adjustable Bluetooth range and geolocation detection per door.
19. Two-factor authentication.
20. Unlock requests while mobile app is in background and mobile device is turned on, but not unlocked.
21. Admin app: Provision wireless locks, download audit logs, user management, and update access.
22. Third-party Allegion ENGAGE mobile app: Commission Schlage enrollment reader and wireless locks into ENGAGE site, and view real-time battery status.
23. Supports video in Avigilon Video Reader Pro
24. Supports video, call routing, and intercom calling in Avigilon Video Intercom Reader Pro

F. Logging into the mobile app:
1. Support passwordless login.
2. Support logging in with a password.
3. Support Okta SSO.

2.10 SMART READERS

A. Basis of Design Product: Avigilon OP-R2X-STND Standard Smart Reader v2, and as follows:
   1. Physical Characteristics:
      a. Dimensions:
      b. With back cover, no gang box: 74 x 120 x 23 mm (2.9 x 4.7 x 0.9 in).
      c. No back cover, on gang box: 74 x 120 x 11 mm (2.9 x 4.7 x 0.43 in).
      d. Front Cover Color: Black.
      e. Mounting: [Flush mounted in gang box] [Surface-mounted] [Surface-mounted with casing and snap cover exposed.
      f. Frequency: LF (125 kHz),HF (13.56 MHz), BLE (2.4 GHz).
   2. LED indicators:
      a. Locked/unlocked status.
      b. Identification status.
      c. Offline.
      d. Configuration.
      e. Insufficient power.
      f. Crossed wires.
   3. Certifications:
      a. CE certification mark for the European Union.
      b. FCC Part 15 certification for the United States.
      c. IC certification mark for Canada.
      d. NOM certification mark for Mexico.
      e. UKCA certification mark for the United Kingdom.
      f. BIS certification mark for India.
      g. RCM certification mark for Australia and New Zealand.
      h. ANATEL certification mark for Brazil.
      i. RoHS certification for Europe.
   4. Regulatory Compliances:
      a. IEC 60529 Environmental Rating: IP65.
      b. ISO 14443A.
      c. UL 294.
         Attack Level I.
         Endurance Level I.
         Line Security Level I.
         Standby Power Level I.
      d. CAN/ULC – 60839-11-1.
      e. UL 62368-1.
      f. UL 60950-22.
   5. Features:
      a. Supports auxiliary Wiegand readers connected through the Avigilon reader
      b. Functions with the Avigilon Alta Open mobile app on both Android and iOS.
      c. Supports PIN functionality.
      d. Supports two-factor authentication (2FA) & multi-factor authentication (MFA).
      e. RS-485 Access control panel connection: 12-inch (305 mm) wiring harness.
   6. Functions:
      a. Wave to unlock.
      b. Auto proximity unlock.

7. Compatibility/Interoperability:
   a. System Compatibilities:
      Avigilon Alta Access System including Avigilon controllers, cloud management software, and the Avigilon Alta Open mobile app and mobile SDK.
      Legacy access control systems via Mobile Gateway option.
      3rd party Wiegand accessories.
   b. Card Compatibilities:
      Avigilon DESFire® EV3-A and EV3-B Smart Card.
      Avigilon DESFire EV3-B Key Fob.
      Avigilon Proximity Card and Avigilon Proximity Fob.
      HID® Proximity.
      LenelProx®.
8. Power Ratings:
   a. 0.25A at 12VDC.
   b. 0.12A at 24VDC.
9. Security Requirements:
   a. Fully encrypted communication between mobile app and controller.
   b. Fully encrypted communication between key cards and reader.
   c. Tamper resistant secure storage.
   d. Fully encrypted PIN transmission between reader and controller.
10. Special Installation Requirements: Use shielded CAT6A cable with recommended maximum cable length of 300ft (91m) with CAT6 or 500ft (152 m) if two wire pairs are used for GND and VIN (power). Review the wiring information chart for additional wiring instructions.

B. Basis of Design Product: Avigilon OP-R2X-MULL Mullion Smart Reader v2, and as follows:
   1. Physical Characteristics:
      a. Dimensions: 43 x 119 x 22 mm (1.7 x 4.7 x 0.86 in).
      b. Color: Black.
      c. Mounting: Surface.
      d. Frequency: LF (125 kHz), HF (13.56 MHz), BLE (2.4 GHz).
   2. LED indicators:
      a. Locked/unlocked status.
      b. Identification status.
      c. Offline.
      d. Configuration.
      e. Insufficient power.
      f. Crossed wires.
   3. Certifications:
      a. CE certification mark for the European Union.
      b. FCC Part 15 certification for the United States.
      c. IC certification mark for Canada.
      d. NOM certification mark for Mexico.
      e. UKCA certification mark for the United Kingdom.
      f. BIS certification mark for India.
      g. RCM certification mark for Australia and New Zealand.
      h. ANATEL certification mark for Brazil.

i. RoHS certification for Europe.

4. Regulatory Compliances:
   a. IEC 60529 Environmental Rating: IP65.
   b. ISO 14443A.
   c. UL 294.
      Attack Level I.
      Endurance Level I.
      Line Security Level I.
      Standby Power Level I.
   d. CAN/UL 60839-11-1.
   e. UL 62368-1.
   f. UL 60950-22.
5. Features:
   a. Supports auxiliary Wiegand readers connected through the Avigilon reader.
   b. Functions with the Avigilon mobile app on both Android and iOS.
   c. Supports PIN functionality.
   d. Supports two-factor authentication (2FA) & multi-factor authentication (MFA).
   e. RS-485 Access control panel connection: 12-inch (305 mm) wiring harness.
6. Functions:
   a. Wave to unlock.
   b. Auto proximity unlock.
7. Compatibility/Interoperability:
   a. System Compatibilities:
      Avigilon Alta Access System including Avigilon controllers, cloud management software, and the Avigilon Alta Open mobile app and mobile SDK.
      Legacy access control systems via Mobile Gateway option.
      3rd party Wiegand accessories.
   b. Card Compatibilities:
      Avigilon DESFire® EV3-A and EV3-B Smart Card.
      Avigilon DESFire EV3-B Key Fob.
      Avigilon Proximity Card and Avigilon Proximity Fob.
      HID® Proximity.
      LenelProx®.
8. Power Ratings:
   a. 0.25A at 12VDC.
   b. 0.12A at 24VDC.
9. Security Requirements:
   a. Fully encrypted communication between mobile app and controller.
   b. Fully encrypted communication between key cards and reader.
   c. Tamper resistant secure storage.
   d. Fully encrypted PIN transmission between reader and controller.
10. Special Installation Requirements: Use shielded CAT6A cable with recommended maximum cable length of 300ft (91m) with CAT6 or 500ft (152 m) if two wire pairs are used for GND and VIN (power). Review the wiring information chart for additional wiring instructions.

2.11 VIDEO INTERCOM/READERS (FRONT ENTRANCE ONLY)

A. Basis of Design Product: Avigilon OP-VID-PRO-INT Avigilon Video Intercom Reader Pro:
   1. Physical Characteristics:
      a. Dimensions: 47 x 155.5 x 31.9 mm (1.85 x 6.12 x 1.26 in).
      b. Color: Black.
      c. Mounting: [Surface with cradle bracket] [Surface with mounting plate] [Recessed with US gang box].
      d. Frequency: LF (125 kHz), HF (13.56 MHz), BLE (2.4 GHz).
   2. LED indicators:
      a. Power On/Off.
      b. User access granted/denied
      c. Entry door locked/unlocked status.
      d. Identification status.
      e. Offline.
      f. Configuration.
   3. Certifications:
      a. CE certification mark for the European Union.
      b. FCC Part 15 certification for the United States.
      c. IC certification mark for Canada.
      d. NOM certification mark for Mexico.
      e. UKCA certification mark for the United Kingdom.
      f. BIS certification mark for India.
      g. RCM certification mark for Australia and New Zealand.
      h. ANATEL certification mark for Brazil.
      i. RoHS certification for Europe.
   4. Regulatory Compliances:
      a. IEC 60529 Environmental Rating: IP65.
      b. ISO 14443A.
      c. UL 294.
         Attack Level I.
         Endurance Level I.
         Line Security Level I.
         Standby Power Level I.
      d. CAN/UL 60839-11-1.
      e. UL 62368-1.
      f. UL 60950-22.
   5. Functions:
      a. Wave to unlock.
   6. Features:
      a. Built-in camera records entry activity
      b. Supports Avigilon’s Triple Unlock technology.
      c. Can connect to third-party legacy access control panel.
      d. Indoor/outdoor design.
      e. Capable for reading and forwarding QR codes to third-party systems.
      f. RS-485 Access control panel connection: 12-inch (305mm) wiring harness.
   7. Audio Features:
      a. Audio Speaker: One 2W speaker.
      b. Microphone: Two (2) onboard microphones.
      c. Noise Cancelation: Manufacturers standard.
      d. Audio Encoding: G.711u, G.711a, G.726.

8. Intercom Features:
    a. Call Routing:
        Direct Connect: Visitors call users by stating their name.
        Front Desk Connect: Visitors call a group of users designated as the front desk.
        Unit Connect: Visitors call one or more users by stating the unit or apartment.
        Visual Voicemail: Visitors may leave a voicemail to be seen by a site administrator.
    b. Virtual Directory: Print QR codes for visitors to access a directory on their mobile phone.
    c. Motion Detection: Detects activity and starts recording.
    d. SIP Mode: SIP-enabled and voice over IP calling on legacy systems.
    e. Languages for Voice Assistant Interaction:
        English (US).
        Spanish (ES).
        Spanish (MX).
        French (FR).
        Italian (IT).
        German (DE).
        Polish (PL).
9. System Performance:
    a. Image Sensor: 1/2.5 inch 5MP CMOS.
    b. Resolution: 5MP (2592 x 1944) recording at 25 fps.
    c. Video Compression: H.264, MJPEG.
    d. Bit Rate: CBR, VBR, MBR.
    e. Focal Length: 2.8mm (F1.6).
    f. Field of View:
        Horizontal: 109 degrees.
        Vertical: 81 degrees.
        Diagonal: 136 degrees.
    g. Minimum Illumination:
        Color mode: 2.5 lux.
        Monochrome mode: 0.0 lux (IR on).
    h. IR Range: 9 m (29.53 ft).
    i. Wide Dynamic Range: HDR (87dB).
    j. Operating Temperature:
        -40C to 50C (-40F to 122F).
        Cold start -25C (-13F).
    k. Operating Humidity: Up to 90% relative humidity, non-condensing.
    l. Power Ratings:
        Input Voltage: 802.3af PoE (48VDC).
        Power Consumption: 7.8W.
    m. Video Storage Capacity:
        Edge storage: 10GB eMMC (network failover recording).
        Cloud storage: 30, 60, 90, 180 plans available.
10. Compatibility/Interoperability:
    a. System Compatibilities:

Avigilon Access System including Avigilon controllers, cloud management software, and mobile app.
Legacy access control systems via Mobile Gateway option and Standalone Mode.
Third-party VMS software via open video standards.
Supports auxiliary Wiegand readers connected through the Avigilon reader.
Functions with the Avigilon Alta Open mobile app on both Android and iOS.
Supports PIN functionality.
Supports two-factor authentication & multi-factor authentication.

b. Card Compatibilities:
Avigilon DESFire® EV3-A and EV3-B Smart Card.
Avigilon DESFire EV3-B Key Fob.
Avigilon Proximity Card and Avigilon Proximity Fob.
HID® Proximity.
LenelProx®.

11. Security Requirements:
a. Fully encrypted communication between mobile app and controller.
b. Fully encrypted communication between key cards and reader.
c. Tamper resistant secure storage.
d. Fully encrypted PIN transmission between reader and controller.

12. Special Installation Requirements: Use shielded CAT6A cable with recommended maximum cable length of 300ft (91 m) with CAT6 or 500ft (152 m) if two wire pairs are used for GND and VIN (power). Review the wiring information chart for additional wiring instructions.

2.12 INTRUSION DETECTION SYSTEM

A. BASE PANEL

1. The security control panel shall have a base capacity of 16 fully supervised and programmable zones with integral power supply and supervised battery charger, auxiliary power for powering security detection devices, program switched auxiliary power supply for 4-wire smoke detectors, integral supervised digital alarm communicator, two general purpose program controllable outputs which can be programmed as general-purpose outputs or as Addressable loops and a supervised bell/siren output. One 12Amp hour battery is required for backup power for each panel.

B. PANEL ZONE EXPANSION

1. The panel shall be expandable to a maximum of 128 zones by adding standard hardwired 8 and/or 16 zone modules connected to the base panel via a supervised four-wire power/communication bus, by adding up to 112 addressable detection devices to one or both addressable loops on the base panel or by adding 64 zone

433 MHz. Narrow Band wireless receivers (to expand coverage area, up to 8 receivers shall be supported) to the four-wire communication bus. The system shall be capable of expansion using hardwired, addressable and wireless simultaneously in any mix that suits the application. The system shall support hardwired seismic sensors and programmable scheduled testing of these seismic sensors.

C. SYSTEM KEYPADS

1. The system shall accommodate up to 16 LCD keypads which are powered from the base panel via the four-wire communications bus. LCD keypads shall have a display capacity of at least 32 alphanumeric characters with the display having brightness and contrast control. Control keys shall be backlit for low light level ease of use. The keypads shall include individual "Armed", "Ready" and "Trouble" indicators and five programmable 'function' buttons and three keypad activated alarm buttons. Keypads shall have the capability to operate in a power-save mode in the event of a power failure.

D. ALTERNATE REPORTING METHODS

1. The system shall be capable of reporting all alarms, trouble and system status information over various combinations of the single integral digital alarm communicator, the dual digital alarm communicators, a cellular transmitter, an internet (IP) communicator and over a dedicated line DVAC channel.

E. CENTRAL STATION REPORTING

1. The system shall provide high speed 20 bps 1400/2300 Hz. handshake, contact ID and SIA reporting formats and shall be capable of being programmed to call up to 3 telephone numbers. The system shall also allow communication to a pager. The telephone numbers shall be programmable for 'backup' dialing should the primary number fail. The system shall be programmable for split reporting such that alarms/restorals, openings/closing and miscellaneous events can be sent to different telephone numbers or communication paths.

2. The system shall report an account code for each partition and a separate account code for non-partition (system) events.

3. The system shall provide opening/closing scheduled suppression to prevent opens and closes from being reported to the central station.

F. HARD COPY PRINTOUT

1. The system shall be capable of including a serial output for a hard copy printer. All system events, alarms and restorals shall be printed and each event shall include the date and time.

G. OUTPUT RELAYS

1. The system shall be capable of including up to 64 fully programmable output relays with each relay having form 'C' contacts rated 2 Amps at 30 VDC. Relays shall be added in increments of four and may be located anywhere on the communication bus. Relay modules shall include an integral power supply, supervised battery charger and supply up to 1.0 Amp of auxiliary power at 12 VDC.

H. LOW POWER OUTPUTS

1. The system shall be capable of including up to 144 low power outputs with each output able to source 50 mA at 12 VDC. Outputs shall be added in increments of 16 and may be added anywhere on the communications bus.

I. REMOTE ANNUNCIATION

1. The system shall be capable of remote zone alarm and system status annunciation, up to 144 points, by adding 32 and/or 64 point annunciators anywhere on the 4-wire communications bus. Annunciators shall be capable of being flush mounted. The annunciators shall provide bull's eye and graphic annunciation capability.

2. The dual access control module shall accept a variety of proximity readers, magnetic stripe readers and any 26-bit Wiegand reader and readers shall be capable of being located up to 500 feet from the module. The dual module shall have inputs for two 'request-to-exit' detectors, two 'postpone arm' pushbuttons, two 'arm' pushbuttons, two 'door' contacts and two outputs for door strikes.

3. Access control software shall be an integral component of the base panel software and shall provide the following functions: capacity for 1,500 cards and up to 64 access levels, 99 seven-day schedules with 4 intervals per schedule, holiday scheduling for a two-year period, individual door unlock schedules, a programmable option to require 2 cards to open a specific door, ability to unlock doors automatically on fire alarm and automatic daylight saving time adjust. Access control functions shall be fully programmable through any system keypad and either locally or remotely using any PC and the upload/download software.

4. All access control transactions shall be recorded in the systems 3,000 event buffer for viewing via the keypad, for printing on a local printer or viewing locally or remotely via the upload/download software.

J. VOICE ASSISTED STATUS AND CONTROL

1. The system shall be capable of adding a module to provide system status and control via any local or remote touch-tone telephone with the system providing system status information by voice. The system shall include a word library and allow custom words for zone labels.

K. AUTOMATION CONTROL

1. The system shall be capable of controlling by event and/or by schedule up to 32 control devices. The automation control module shall connect to the system via the 4-wire communications bus. The system shall include

2. 16 schedules to control the automation devices. Automation shall be controllable via any keypad and local or remote touch-tone telephone.

L. SYSTEM SOFTWARE

1. The base panel shall come complete with all the software to implement every system feature and allow the addition of every expansion or functional module without changes or addition to the basic software.

M. SYSTEM PROGRAMMING

1. The system shall be fully programmable via the LCD keypads and shall also allow event buffer viewing via the keypads.

2. Separate PC based Upload/Download software shall provide the ability to fully program the system and read all current system programming and the event buffer. The system shall provide a connector on the base panel to allow local upload/download operation and shall be capable of being remotely, over the telephone lines or internet (IP network), uploaded or downloaded. The system shall provide a separate telephone number that can be called for the remote upload/download operation. Remote upload/download access shall be controllable by the user to prevent unauthorized access.

3. All system programming shall be maintained in non-volatile memory such that program information is maintained even if all AC and battery power is removed.

N. USER CODES

1. The system shall provide for 1,500 user codes selectable as either 4 or 6 digits. For Access Control, user codes shall be assignable to 1 of 64 access levels. User codes shall assignable to one or multiple partitions. The system shall offer a programmable option to allow users to program their own access code. The system shall offer a programmable option to require 2 users to disarm certain partitions.

O. PARTITIONS

1. The system shall be programmable for up to 8 fully independent partitions each partition shall have its own account code. Keypads shall be assignable as ‘partition’ keypads or ‘global’ keypads. Each zone in the system shall be assignable to one or more partitions.

P. SCHEDULING

1. The system shall provide for 99 date schedules with 4 intervals per schedule, 4 holiday schedules with 2 years of scheduling capacity, 50 open/close suppression schedules and 16 automation schedules. All schedules shall be programmable via the LCD keypads and via downloading either locally or remotely.

Q. GROUND FAULT DETECTION

1. For commercial fire installations, the system shall include an integral ground fault detector which shall detect a single ground fault on any extended conductor in the system.

R. SUPERVISION

1. Each zone in the system shall be supervised. General system supervision shall include; loss of AC for the base panel and any remote functional. Provide 4 state supervision for all intrusion devices. The panel with its own AC input, batteries for the base panel and all remote functional panels shall be supervised and short circuit protected, each addressable device and each wireless input device shall be supervised for it presence and the 4-wire communication bus shall be supervised for low voltage and the presence of each enrolled module and keypad. Digital alarm communicators shall be supervised for telephone line trouble and failure to communicate and the system shall report any cellular or IP network communication panel trouble.

S. FALSE ALARM PREVENTION

1. The system shall include the following false alarm prevention features: audible exit delay, arm/disarm bell squawk, audible exit fault, urgency on entry delay, no entry arming/disarming, swinger shutdown programmable by zone, transmission delay by zone, AC fail, TLM trouble and low battery trouble transmission delay, rotating keypress buffer, recent close code transmission, police code (cross zone) transmission, scheduled seismic sensor testing and opening after alarm transmission.

T. AUTOMATIC ARMING/DISARMING

1. The system shall allow for automatic arming and disarming partition(s) according to a programmable schedule. The system shall include a method to automatically arm a partition after it has been disarmed for a set period of time. The system shall include a programmable limitation for basic users which shall delay disarming a specific partition for a set period of time.

U. TEMPORARY ZONE DISABLING/BYPASSING

1. The system shall include the following temporary zone disabling/bypassing features: arm partition with zone violated and arm zone upon restore, manual zone bypass by user, temporary bypass of a programmable group of zones which shall re-activate zones after programmable time.

V. NETWORK COMMUNICATIONS

1. The system shall be capable of network (LAW/WAN) and Internet communications according to ULC Level5 and/or UL-AA (Highline Security) standards. The Network communicator shall utilize 128-bit AES encryption over 10/100 base-T networks and support static or dynamic IP addressing. The IP communicator shall be capable of sending alarm events to a primary and backup IP receiver address and up to two standard email addresses. The internet communicator shall perform full alarm reporting directly to the central monitoring station as well as performing full system configuration programming and viewing system status using remote upload/download software over encrypted connection. For security purposes, the internet communicator shall be capable of end-to-end supervision and hardwire substitution detection.

W. DUAL TECHNOLOGY MOTION SENSORS

1. The dual technology sensor shall use both microwave and PIR as detection methods. Sensor shall have a detection range of a minimum of 40ft. Unit shall be either wall or ceiling mountable. Current draw shall be 17 milliamps at 12VDC. Unit shall be no large than 5in x 2.76in x 2in in size or in ceiling mounted no larger than 3.5in in diameter. Unit shall be wired with 4 state line supervision.

X. GLASS BREAK DETECTORS

1. Glass break sensor shall be an acoustic type sensor that had a minimum detection diameter of 50ft. The detector shall have pattern recognition technology that listens for actual patterns of glass breaking and eliminating the false alarms patterns. Alarm response must be a minimum of 4 seconds. The unit shall be a maximum of 4 inches in diameter or 4.6 inches x 2.75 inches x 1 inch. Current draw must not exceed 25 milliamps.

Y. Acceptable Manufacturers:

1. Honeywell Vista 128
2. Or Approved Equal

2.13 VIDEO MANAGEMENT SYSTEM (VMS)

A. Provide all necessary VMS software and licensing for integration with the security management system to meet the following:
   1. Contractor to provide new Avigilon cameras (H5A – multisensory & H6SL – domes) to be tied into existing City of Providence Avigilon cloud based system.
   2. Provide all camera licenses
   3. Update software to latest version
   4. Video Surveillance Cameras

      a. Fixed IP Cameras shall be 1/ 1.8 inch Progressive CMOS, 5MP (exterior, door entrance), 3.4-10.5 mm varifocal lens, WDR and be IR compatible, Avigilon Alta P/N: 5.0C-H6SL-D01-IR-30

      b. Fixed IP Cameras shall be 1/ 2.8 inch CMOS, 3MP (interior), 3.4-10.5mm mm varifocal lens, WDR and be IR compatible, Avigilon Alta P/N: 3.0C-H6SL-IR-30.

      c. 360* (Fisheye) type interior camera shall be 1 2.3 inch sensor,12MP, HDR, Avigilon Atla P/N: 360-W-30. Provide dewarping/stitching software as required.

      d. Multi-sensor exterior cameras shall have 1/2.8” CMOS with a total of (4) 8MP gimbals, totaling 32MP, 3.3-5.7mm, WDR Day/Night, IP67 and IK-10 rated, interchangeable lenses and Remote Focus, and stitching of video, Avigilon Alta P/N: 32C-H5A-4MH-30

      e. For IP devices over 300ft from the MDF an Ethernet extender may be used. It shall be able to extend an additional 300ft from the power source, and be capable to extend IP video and POE to 3000ft.

      f. Camera type, location, enclosure and mounting requirements shall be as indicated on the Security Device Drawings.

      g. Provide infrared modules at all the exterior cameras

h. All Cameras shall be powered by PoE802.3af

1) Video surveillance cameras with pan, tilt and zoom capabilities shall be configured such that any and all future SMS alarm points or card reader controlled doors or emergency phones located within the available field of view are programmed as presets for automatic viewing and real time recording. Applicable alarms generated by the SMS shall cause the camera to pan around, tilt up or down as required, and zoom in on the alarm event. Verify all preset positioning with the Owner prior to system programming.
a) Cameras may require injectors.

i. Lenses

1) Provide lenses for the field of view intended as indicated on the Security Device Drawings. Field verify lens requirements to provide for the defined desired angle of view, and high quality, glare-free, clear pictures at the video monitors.

2) Varifocal lenses are acceptable.

3) All camera lenses shall incorporate auto iris control.

j. Acceptable Manufacturers:

a) Avigilon
(1) Refer to camera schedule for additional information.

5. Video Surveillance Camera Housings and Mounts

a. Provide video surveillance camera housings and mounts required for each camera based on field conditions (exterior corner mounts, ceiling, pendent, wall, etc)

b. Wiring to all cameras shall pass from the back box through the mount and into the housing. Exposed wiring or liquid tight of any kind shall not be acceptable.

c. Provide sun shields/tinted bubble for camera housings in outdoor locations exposed directly to sunlight.

d. Provide weather and dust proof camera housings with thermostatically controlled heaters and blowers in outdoor locations.

e. Provide lightning protection for power, control, and network cables for all exterior cameras.

2.13 WIRE AND CABLE

A. Minimum Specifications:

1. All wire and cable shall be Underwriter's Laboratories (UL) approved for its intended application, shall meet all national, state and local code requirements for its application, and shall meet or exceed manufacturers' recommendations for the components connected.

2. Provide plenum-rated cable as required by code.

3. All wire and cable shall meet individual system or subsystem manufacturer specifications.

4. All insulated wire and cable shall conform to the minimum requirements of Insulated Cable Engineers Association (ICEA) Standards.

5. Wire and cable shall comply with the applicable requirements of the National Electrical Code (NEC), latest edition, in regards to cable construction and usage.

6. The conductors of wires shall be copper, and have conductivity in accordance with the standardization rules of the Institute of Electrical and Electronics Engineers, Inc. (IEEE). The conductor and each strand shall be round and free of kinks and defects.

7. Insulation shall be rated for a minimum of 300 V.

8. Color coding shall be accomplished by using solidly colored insulation. Grounding conductors, where insulated, shall be colored solid green or identified with green color as required by the National Electric Code (NEC).

9. All category cabling (Category 6A) shall be in strict accordance with the division 27 specification, and be provided for by the telecommunications contractor.

10. The structure cabling system for the integrated security system must be manufacturer certifiable.

B. Minimum Wire Types and Sizes

1. Low Voltage Power Cable: Wire size shall be a minimum of 18 AWG, twisted, stranded, insulated and jacketed.

2. Control Point Cable (Non-Power): Wire size shall be a minimum of 20 AWG, twisted, stranded, insulated and jacketed.

3. Control Point Cable (Low Voltage Power): Wire size shall be a minimum of 18 AWG, stranded, insulated, and jacketed.

4. For all IP devices provide category 6 UTP plenum cable as detailed in the 27000 UTP specification.

PART 3 EXECUTION

3.1 GENERAL

A. The requirements of Part One and Part Two also apply to the execution of the work.

B. When a Manufacturer, or authorized Representative accepts an order for material and equipment, they agree to adjust Submittals and production schedules as required to accommodate the project schedule. Schedules shall be included with Submittals indicating review times as specified herein and manufacturing and delivery times such that material and equipment will be manufactured and delivered to the site sufficiently ahead of schedule so as not to delay the completion of the work.

C. Prior to bid, inspect the site, existing conditions, fully understand the Work required, and provide the Work according to Contract Documents and all existing site conditions. Confer with the Manufacturer's of existing systems to be retained, modified or extended. Include all required costs and components for a fully functional system performing as indicated herein and on the Drawings. No additional compensation will be granted because of existing conditions.

D. Verify the exact location prior to bid of all items that may be indicated and determine exact location of all electrical items that are not indicated on the Drawings.

E. Any work installed contrary to the Contract Documents or written directions from the Architect shall be subject to change as directed by the Architect and no extra compensation will be allowed for making these changes or any work of any other trade due to these changes.

F. Upon completion of work, the security contractor shall submit a testing and commissioning report for engineer/architect/owner approval. This document shall be in a excel spreadsheet format.

G. Upon approval from the engineer/architect/owner of the testing and commissioning report shall commence the warranty period.

H. Equipment and systems shall not be installed without first coordinating the location and installation of equipment and systems with all other Trades.

I. Any and all material installed or work performed in violation of above requirements shall be re-adjusted and corrected by the Installer without charge.

J. Refer to all Drawings associated with the project, prior to the installation or roughing-in of outlets, conduit and equipment, to determine the exact location of all outlets.

K. Assure that all equipment is accessible, such as junction boxes, pull boxes, controls and such other apparatus as may require maintenance and operation from time to time. Security

contractor to coordinate with electrical provided construction access panels sized in order to provide adequate and required access for installation. Provide rated panel or door appropriate for the construction being installed into (fire, smoke and/or acoustical).

L. After installation, equipment shall be protected to prevent damage during the construction period. Openings in conduits and boxes shall be closed to prevent the entrance of foreign materials.

M. Home runs indicated are not to be combined or reduced without written consent from the engineer.

N. All connections to equipment shall be made as required, and in accordance with the approved submittal, setting drawings, and manufacturer's guidelines.

O. Site Observation:

1. Site observation visits will be performed randomly during the project by the engineer. Reports will be generated noting observations. Deficiencies noted on the site visit reports shall be corrected. All work shall comply with the Contract Documents, applicable Codes, regulations and local Authorities whether or not a particular deficiency has been noted in a site visit report.

2. The general contractor or construction manager is responsible to notify the engineer ten working days prior to closing in work behind walls, raised access floors, ceilings, etc., so that installed work can be observed prior to being concealed.

3. Work concealed prior to observation and correction of deficiencies shall be made accessible for review at the discretion of the engineer. Bear all costs for allowing work to be reviewed.

4. Areas shall stay accessible until deficiencies are corrected and accepted. Notify the Engineer when all deficiencies are corrected. Return reports with items indicated as corrected prior to re-observation by the engineer.

3.2 SITE INSPECTION

A. Security contractor to continuously verify that the site conditions are in agreement with the Contract Documents and the design package. Submit a report to the Engineer documenting changes to the site or conditions that affect the performance of the system to be installed. For those changes or conditions, which affect system installation or performance, provide (with the report) specification sheets, or written functional requirements to support the findings, and a cost estimate to correct the deficiency. No deficiency shall be corrected without written permission from the Engineer.

P. Specific mounting locations, exact wire and cable runs, and conduit routing have not been specified or delineated on the Security Device Drawings. Coordinate all aspects of the Work with the engineer/architect/construction manager.

3.3 INSTALLATION

A. Coordination

1. Security contractor to coordinate with the GC/electrical contractor to ensure that adequate conduit is provided and that equipment backboxes are adequate for system installation.

2. Security contractor to coordinate with the Electrical contractor to ensure that adequate power has been provided and properly located for the security system equipment, and door hardware.

3. Security contractor to coordinate with the general contractor/construction manager to ensure that doors and doorframes are properly prepared for electric locking hardware and door position switches.

4. Security contractor to coordinate with the door hardware contractor to ensure that the appropriate architectural/security door hardware is installed.

5. Security contractor to coordinate locations of all devices with the general contractor/construction manager and architect prior to installation.

6. Security contractor to coordinate and verify the location of each piece of rack-mounted equipment with the engineer and owner's IT.

7. Security contractor to coordinate custom SMS report requirements with the Owner. Submit report formats to the Owner for review and acceptance.

8. Security contractor to coordinate all access rights, time zones, lockdown, cardholder group and other SMS programming parameters with the owner.

9. Security contractor to coordinate all initial database partitioning and setup with the Owner prior to initial programming and card holder data entry.

10. Security contractor to coordinate camera housing and mount finishes with the architect/owner prior to installation.

11. Security contractor to coordinate finishes and colors of all equipment with the architect/owner. Submit all finish and graphics for all equipment in public areas to the Engineer for approval prior to installation.

12. Security contractor to coordinate all requirement penetrations both interior and exterior with architect and construction manager.

13. Security contractor to coordinate all fire stopping with construction manager/architect as require by code.

14. Security contractor to coordinate with owner's IT for all network based requirements. This shall include but not be limited to IP address, DHCP server requirements, cyber security requirements, and network traffic management requirements.

15. Security contractor to coordinate all requirement of the turnstiles with the architect, engineer, and construction manager.

16. Installation methods must be in strict accordance with ANSI/BICSI 005-2016, owner's standards, and manufacturer's guidelines.

17. Mounting heights for all device must comply with ADA standards.

18. Security contractor shall be in compliance with the NEC, IBC, and other local codes that are required by the AHJ.

B. General

1. Security contractor to verify acceptance of each type of specified request-to-exit hardware for each application with local life safety code officials.

2. Security contractor to verify fail-safe and fail-secure lock requirements with the architect and engineer.

3. Contractor or equipment manufacturer logos or names shall not be visible on equipment in public areas.

4. Security contractor to provide tamper proof fasteners for all equipment in public areas. Fastener finish shall match equipment finish.

C. Conduit shall be used in all garage areas, and exposed areas. Contractor's conduit design layout shall be coordinated and approved by architect, engineer, and construction manager. All conduits shall have no more than a 40% fill at the end of the project.

D. If approval by architect/engineer, hanger assemblies located the garage areas and areas exposed to the weather, including; anchors, clamps, threaded rod, nuts, washers and pipe hanger shall be provided with a factory applied hot dipped galvanized coating. Any components or assemblies that require field modification, cutting, welding, or removal of the applied hot dipped galvanized coating shall be repainted with the appropriate coating.

E. Equipment: Installation requirements are as follows:

1. Data Gathering Panel Locations

a. Security contractor to provide the following:

1) Configure security equipment as indicated in the Security Device Drawings.

2) Wire all power supply power fail alarm contacts in each equipment room as a single alarm input to the SMS.

3) Wire each power supply low battery alarm contact as individual alarm inputs to the SMS.

2. Data Gathering Panels

a. Security contractor to provide the following:

1) Configure the system such that devices can be connected to spare input points, output points and card reader inputs on the Data Gathering Panel without requiring reconfiguration of the SMS.

2) Configure the Data Gathering Panel IP communication chains such that no more than 16 Doors (including all possible spare card readers) shall be connected to each Data Gathering Panel IP chain. RS-232 and RS-485 chains without direct connection to an IP network is not permitted.

3. Card Readers

a. Security contractor to provide the following:

1) Wire card reader LEDs to indicate valid and invalid card reads, and door locked and unlocked conditions. All card reader LED indicators shall operate identically.

4. Electric Locking Mechanisms

a. Security contractor to provide the following:

1) Provide connection to electric locking mechanisms provided by the hardware contractor.

2) Wire electric locking mechanism as indicated on the Security Device Drawings.

3) Wire fail-safe electric locking mechanisms in accordance with local codes.

4) Wire fail-secure electric locking mechanisms and power supplies such that locks remain powered and operational during a fire alarm condition or building power failure.

5. Fire Alarm Interface

a. Security contractor to provide the following:

1) Connect (hard wire) fail-safe electric and time delay locking mechanisms to the building fire alarm system for fail-safe release upon any fire alarm.

2) Interface with a single low voltage/low current normally closed dry contact from the fire alarm system provided by the fire alarm contractor in the Fire Command Center (FCC). The contact will open on any fire alarm condition.

3) Provide all additional UL listed fail-safe relays and power supplies necessary to interface to this contact and unlock all fail-safe doors.

4) Connect fail-safe relays and UL listed power supplies to standard building power. Connection of fail-safe devices to emergency or UPS power shall not be acceptable.

5) Reference the Security Device Drawings for fire alarm interface requirements.

F. System Programming and Data Entry

1. Security contractor to provide all initial system programming and setup of the SMS including, but not limited to the following:

a. Graphical maps and icons. Coordinate with the Engineer to obtain AutoCAD Owner/Architectural backgrounds for implementation as graphical maps. Import all AutoCAD background information provided by the Engineer and produce a complete set of graphical maps depicting all SMS points.

b. SMS card reader information. Coordinate all card reader values and text, including descriptors, alarm messages, Camera call up, map call up and identification with the Owner and Engineer.

c. Input and output points for the SMS. Coordinate all input and output priorities and text, including descriptors, alarm messages, camera call up, and map call up and identification with the Owner and Engineer.

d. Initial system Card Reader information. Coordinate all Card Reader values and text, including descriptors, alarm messages, camera call up, map call up and identification, with the Owner.

e. Input and output points for the SMS. Coordinate all point priority and point text, including descriptors, alarm messages, camera call up, map call up and identification, with the Owner.

f. Initial camera call up and alarm information for interface with Video Management System.

g. Initial camera call up and alarm information for interface with Intercom System. Coordinate all inputs and outputs for the intercom system with the SMS for seamless action through the master station.

2. Security contractor to provide all initial system programming and setup of the Security Management System including, but not limited to the following:

a. Initial setup for the interface with the SMS. The interface shall provide for automatic video surveillance Camera selection upon alarms within the SMS as defined in the Specification. Coordinate automatic video surveillance Camera selection, real-time record initialization, and record status alarm annunciation requirements with the Owner prior to programming.

b. On-screen alphanumeric identification of each VIDEO SURVEILLANCE Camera, on each Monitor. Coordinate descriptors with the Owner prior to programming.

c. Automatic selection of a VIDEO SURVEILLANCE Camera adjacent to a Card Reader upon an invalid card use. Coordinate automatic camera selection requirements with the Owner prior to system programming.

d. Programming triggers for the video surveillance analytical references.

3.4 WIRING TECHNIQUES

A. Security contractor or construction manager to provide code compliant fire proofing techniques for all penetrations of fire rated partitions and slabs, where the penetrations are made by or used for installation of the Security System.

B. Route all wire and cable as required to prevent interference and signal contamination of both security system cable and cable associated with other systems. Coordinate the routing of wire and cable requiring isolation from power, radio frequency (RF), telephone, etc. with the Owner.

C. Separate 120 VAC and other line voltage cables from low voltage cables within enclosures.

D. Wire nuts shall not be an acceptable means of connecting wire and cable. Use B-wire crimp connectors or equal.

E. Splicing of cable is not acceptable. All cabling shall be home run back to its designated closet.

F. Run all wire and cable continuous from device location to the final point of termination. No mid-run cable splices will be allowed unless approved by the Engineer.

G. Securely fasten junction boxes to the building structure.

H. Secure junction box covers with tamperproof screws

I. Provide compression type fittings to secure cable at junction box openings.

J. Make cable connection for device terminations in junction boxes with crimp type connectors. Connectors shall provide a hermetic seal and test probe access such that the circuit may be checked without breaking the connection.

K. Ensure all that back boxes and junction boxes have the approved an UL listed cover.

L. All RJ45 male connectors shall be UL listed.

M. All security cabling shall be done in strict accordance with ANSI/BICSI 005-2016, Electronic Safety, and Security System Design, and Implementation.

N. Component Connections

1. Prepare wire ends for attachment to components in accordance with manufacturer recommendations.

2. Wherever possible, and unless otherwise recommended by the manufacturer, connect individual wire conductors with crimp type spade lugs.

O. Grounding

1. Establish an earth ground connection within each Data Gathering Panel location. The intent of the earth ground is to prevent ground loops within security system circuits, ensure proper communications between system components and devices, and isolate security equipment from building electrical system noise.

2. Connect all security equipment located at each Data Gathering Panel location to the earth ground connection at each location.

3. Under no conditions shall the AC neutral, either in a power panel or in receptacle outlets, be used for a reference ground.

4. Provide all necessary hardware and cable to properly ground security equipment.

5. Ground all equipment according to the manufacturer recommendations for each piece of equipment. The Contractor shall be responsible for any damage to equipment or communications problems that may occur due to improper grounding.

P. Testing

1. Test all cabling for continuity before connection to data gathering panels, cameras etc.

3.5 POWER REQUIREMENTS

A. Emergency backup 120 VAC power will be dedicated for the Security System as indicated on the Electrical Device Drawings. Coordinate with the Engineer to establish locations of security dedicated 120 VAC circuits.

B. Connect to the AC power and provide UL listed power supplies and transformers to distribute low voltage power to the system components as required.

C. Provide hinged cover terminal cabinets with tamper switches that are lockable for all power supplies, transformers and power distribution terminal strips. Provide all conduit and wiring from the AC power facilities to the terminal cabinets.

D. All power supplies are to be installed in accordance with manufacturer's guidelines in an effort to maintain its UL listing.

E. Surge Protection

1. Provide protection against spikes, surges, noise, and other line problems for all system equipment and components.

2. Protect all exterior and building-to-building video, control, power, signal cables and conductors against power surges. Video surge protectors shall not attenuate or reduce video and sync signals under normal conditions. Each surge protector shall be UL Listed.

3.6 LABELED DOORS AND FRAMES

A. In no instance shall any UL labeled door or frame be drilled, cut, penetrated, or modified in any way.

B. The Contractor shall be responsible for replacing any labeled door or frame that is modified without written approval from the Engineer.

3.7 LABELING

A. Place wire identification numbers on each end of all conductors by using sleeve type, heat shrinkable markers. Wire markers shall be T&B Shrink-Kon Type HVM or equivalent. Install markers to be readable from left to right or top to bottom. Wire numbers shall be computer printed. Hand written labels shall not be acceptable.

B. Mark all connectors with common designations for mating connectors. The connector designations shall be indicated on the record drawings.

C. Permanently mark all terminals. Terminal and cable markings shall agree with markings shown on as-built drawing.

D. Coil all spare conductors in the device backbox or panel wire way. Neatly bundle and tag conductors.

E. All labeling shall be done in strict accordance with ANSI/TIA-606-B standard for labeling.

a. Return competence evaluations for each trainee directly to the Owner.

F. Telephone Support

1. The SMS manufacturers shall establish direct telephone support for the Owner during normal business hours.

2. The Contractor shall provide on call service during the warranty period to answer any questions the Owner's representatives might have.

3. The contractor shall provide 5 days of in service support to the owner. The technician shall be required to be on site during normal working hours, 8 a.m. to 5 p.m. and be available for after hours call back for service related events.

3.8 SYSTEM START-UP

A. The Security System shall be complete and ready to operate prior to the Consultant's final acceptance of the system.

G. Load all of the initial user database as defined in this Section into all programmable systems up to the inaugural day of beneficial use of the system. The Owner will assist in establishing procedural guidelines and in defining terminology and conditions unique to the Owner's operation.

H. Label all controls as necessary to agree with their function.

3.9 SYSTEM ACCEPTANCE

A. Final acceptance testing of the Work will be conducted by the manufacturer's certified rep.

B. Prior to any final acceptance testing, the Security Contractor shall submit two sets of preliminary (draft) Record Drawings to the Engineer. The preliminary Record Drawings are to be used by the Engineer to conduct the system final test.

C. Submit a paragraph by paragraph completion matrix indicating completion or delinquency for each item included in the Specification and all subsequent addenda and bulletins as part of the Work. Indicate completion of the requirement by the word "Completed" following each paragraph number. Indicate delinquency for the requirement by the words "To Be Completed" following the applicable paragraph number. Should work on any item be under way, but not yet fully complete, indicate the extent (or lack thereof) of completion to date, and the proposed date of completion.

D. Conduct a complete test of the entire Security System and provide the Engineer with a written report on the results of that test. During the course of this test, calibrate and test all equipment, place the integrated Security System in service, and test the integrated system.

E. Following completion of the initial testing and correction of any noted deficiencies, conduct a five day burn-in test. The intent of such test shall be to prove the Security System by placing it in near real operating conditions. During this period the Security System shall be fully

functional and programmed such that all points, interfaces, controls, reports, messages, prompts, etc. can be exercised and validated. Record and correct any system anomaly, deficiency, or failure noted during this period. Scheduling of the final acceptance test shall be based on a review of the results of this burn-in test.

F. Deliver a report describing the results of functional tests, burn-in tests, diagnostics, calibrations, corrections, and repairs including written certification to the Engineer that the installed complete Security System has been calibrated, tested, and is fully functional as specified herein.

G. Prior to the final acceptance test, coordinate with the Engineer for security related construction clean-up and patch work requirements. Security equipment closets and similar areas should be free of accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, remove all waste materials, rubbish, the Contractor's and its subcontractors' tools, construction equipment, machinery and all surplus materials.

H. Upon written notification from the Contractor that the Security System is completely installed, integrated and operational, training of owner's staff, and the burn-in testing completed, the Engineer will conduct a final acceptance test of the entire system.

I. During the course of the final acceptance test by the Engineer, the Contractor shall be responsible for demonstrating that, without exception, the completed and integrated system complies with the contract requirements. ALL PHYSICAL AND FUNCTIONAL REQUIREMENTS OF THE PROJECT SHALL BE DEMONSTRATED AND SHOWN. This demonstration will begin by comparing "as built" conditions of the Security System to requirements outlined in the Specification, item by item. Following the Specification compliance review, all Security System head-end equipment will be evaluated.

J. In order to sufficiently demonstrate the Security System's functionality, the console operator on duty and his/her superior will be requested to perform certain daily operations inherent to the Security System. These operations may include, but not be limited to, manually locking and unlocking of doors within the SMS, verifying the status of current alarm/control points within the SMS, responding to alarms, adding/deleting personnel from the card holder database, camera call-up on various monitors, manipulation of PTZ cameras, changing setting on various pieces of equipment As all of these operations depend heavily on the training outlined within the Specification, the Contractor shall have completed all of the required training prior to initiation of the final acceptance test.

K. Demonstrate the functionality of the various interfaces between systems. This will include, but not be limited to, correct camera call-up on certain alarms within the SMS, generation of alarms from related systems failure (e.g. video loss detection alarms loss of communications, etc.), fire alarm system fail safe lock release, and interface to any externally controlled devices and/or database system(s).

L. Following the Security System equipment and workstation review, the installation of all field devices will be inspected. This field inspection will weigh heavily on the general neatness and quality of installations, complete functionality of each individual device, and mounting, backbox and conduit requirements compliance.

M. All equipment shall be on and fully operational during any and all testing procedures. Provide all personnel, equipment, and supplies necessary to perform all site testing. Provide a minimum of two employees familiar with the system for the final acceptance test. One employee shall be responsible for monitoring and verifying alarms while the other will be required to demonstrate the function of each device. Supply at least two two-way radios for use during the test. A manufacturer's representative may be present on site to answer any questions that may be beyond the technical capability of the Contractor's employees, if the Contractor so elects or by specific request of the Engineer or Owner, at no charge to the Engineer or Owner.

N. Upon successful completion of the final acceptance test (or subsequent punch list retest) the Engineer will issue a letter of final acceptance.

O. The Engineer retains the right to suspend and/or terminate testing at any time when the system fails to perform as specified. In the event that it becomes necessary to suspend the test, all of the Engineer's fees and expenses related to the suspended test will be deducted from the Contractor's retainage. Furthermore, in the event it becomes necessary to suspend the test, the Contractor shall work diligently to complete/repair all outstanding items to the condition specified in the Specification and as indicated on the Security Device Drawings. The Contractor shall supply the Engineer with a detailed completion schedule outlining phase by phase completion dates and a tentative date for a subsequent punch list retest. During the final acceptance test, no adjustments, repairs or modifications to the system will be conducted without the permission of the Engineer.

END OF SECTION

SECTION 283100 - FIRE DETECTION AND ALARM SYSTEM - Part of Work of Section 260000

PART 1 GENERAL

1.1. RELATED SECTIONS

A. Section 26 00 00 - Electrical.

B. Section 21 00 00 - Fire Suppression.

1.2. DESCRIPTION:

A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, **the Fire Alarm Control Panel (FACP) is existing-to-remain (per the drawings),** auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.

B. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

C. The fire alarm system devices shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

D. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).

E. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

F. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final checkout and to ensure the systems integrity.

1.3. SCOPE:

A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings. The existing main system shall be reused.

B. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 6 (Class A) Signaling Line Circuits (SLC).

2. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.

3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an

addressable device connected by the SLC Circuit.

4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

C. BASIC SYSTEM FUNCTIONAL OPERATION

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. The system alarm LED on the system display shall flash.
2. A local piezo electric signal in the control panel shall sound.
3. A backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
4. Printing and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

1.4. SUBMITTALS

A. General:

1. Two copies of all submittals shall be submitted to the Architect/Engineer for review.
2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent compatible UL-listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.
3. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show annunciator layout, configurations, and terminations.
4. Include complete Tier 2 shop drawings prepared by the fire alarm company in cad format.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
2. Wiring diagrams shall indicate internal wiring for each device and the interconnections

between the items of equipment.

3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

D. Software Modifications

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site.

E. Certifications:

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.5. GUARANTY:

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.6. POST CONTRACT MAINTENANCE:

A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty applicable to the new work only.

B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

C. Maintenance and testing shall be on a semiannual basis or as required by the AHJ. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:

1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, waterflow switches and all accessories of the fire alarm system.
2. Each circuit in the fire alarm system shall be tested semiannually.

3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 7.

1.8. APPLICABLE STANDARDS AND SPECIFICATIONS:

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

A. National Fire Protection Association (NFPA) - USA:

No. 12	CO2 Extinguishing Systems (low and high)
No. 12A	Halon 1301 Extinguishing Systems
No. 13	Sprinkler Systems
No. 15	Water Spray Systems
No. 16	Foam/Water Deluge and Spray Systems
No. 17	Dry Chemical Extinguishing Systems
No. 17A	Wet Chemical Extinguishing Systems
No. 2001	Clean Agent Extinguishing Systems
No. 72	National Fire Alarm Code
No. 101	Life Safety Code

B. Underwriters Laboratories Inc. (UL) - USA:

No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 217	217 Smoke Detectors, Single and Multiple Station
No. 228	Door Closers - Holders for Fire Protective Signaling Systems
No. 864	Standard for Control Units for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective Signaling Systems
No. 464	Audible Signaling Appliances
No. 38	Manually Actuated Signaling Boxes
No. 1481	Power Supplies for Fire Protective Signaling Systems
No. 346	Waterflow Indicators for Fire Protective Signaling Systems
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems
No. 1971	Visual Notification Appliances
No. 2017	Standard for General-Purpose Signaling Devices and Systems
No. 60950	Safety of Information Technology Equipment

C. Local and State Building Codes.

D. All requirements of the Authority Having Jurisdiction (AHJ).

1.9. APPROVALS:

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:
UL Underwriters Laboratories Inc

PART 2.0 PRODUCTS

2.1. EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2. CONDUIT AND WIRE:

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
2. Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760.
4. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
6. Conduit shall be 3/4-inch (19.1 mm) minimum.

B. Wire:

1. All fire alarm system wiring shall be new.
2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits, Signaling Line Circuits, and Notification Appliance Circuits.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the

installation as indicated in NFPA 70 (e.g., FPLR).

5. Wiring used for the multiplex communication circuit (SLC) shall be twisted and unshielded and support a minimum wiring distance of 12,500 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.
6. All field wiring shall be electrically supervised for open circuit and ground fault.
7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs). Systems that do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.

C. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their use and purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

2.3. MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

A. Main FACP is existing to remain. Expand existing system as required to accommodate the new devices. Any power supplies, booster panels and expansion hardware shall be included.

B. Auxiliary Field Power Supply - Addressable

1. The auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24VDC power. The power supply shall also include and charge backup batteries.
2. The addressable power supply for the fire alarm system shall provide up to a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 10 amps of 24 volt DC general power. The power supply shall have an additional .5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 12.0 - 200.0 amp hour batteries.
3. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as two Class "A" and two Class "B" or four Class "B" only circuits. All circuits shall be power-limited per UL 864 requirements.
4. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.
5. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.
6. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire. Data on the SLC shall be transmitted between 24 VDC, 5 VDC and 0 VDC at approximately 3.33k baud.
7. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the

event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.

8. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of zero, two, eight or sixteen hours shall be programmable.
9. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be programmable.
10. The addressable power supply mounts in either the FACP backbox or its own dedicated surface mounted backbox with cover.
11. Each of the power supply's four output circuits shall be programmed for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
12. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
13. When selected for Notification Appliance Circuits, the output circuits shall be individually programmable for Steady, March Time, Dual Stage or Temporal.
14. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.
15. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
16. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

C. Field Charging Power Supply (FCPS)

The FCPS-24S6/8 is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.

1. The FCPS-24S6 shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 18.0 amp hour batteries and to support 60 hour standby. The FCPS-24S8 shall offer up to 8.0 amps (6.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge up to 18.0 amp hour batteries and to support 60 hour standby.
2. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.
3. The FCPS shall include an attractive surface mount backbox.
4. The Field Charging Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.
5. The FCPS include power limited circuitry, per UL standards.

D. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 0 to 60 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
4. Point Read: The system shall be able to display or print the following point status diagnostic functions:

    a. Device status
    b. Device type
    c. Custom device label
    d. View analog detector values
    e. Device zone assignments
    f. All program parameters

5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.
6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
9. Software Zones: The FACP shall provide 100 software zones, 10 additional special function zones, 10 releasing zones, and 20 logic zones.
10. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without

returning to the panel to reset the system. Operation shall be as follows:

a. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
c. All devices tested in walk test shall be recorded in the history buffer.

11. Waterflow Operation

An alarm from a waterflow detection device shall activate the appropriate alarm message on the main panel display, turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.

12. Supervisory Operation

An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.

13. Signal Silence Operation

The FACP shall have the ability to program each output circuit (notification, relay, speaker etc) to deactivate upon depression of the signal silence switch.

14. Non-Alarm Input Operation

Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

2.4. SYSTEM COMPONENTS:

A. Programmable Electronic Sounders:

1. Electronic sounders shall operate on 24 VDC nominal.
2. Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device.
3. Shall be flush or surface mounted as shown on plans.

B. Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria:

1. The maximum pulse duration shall be 2/10 of one second
2. Strobe intensity shall meet the requirements of UL 1971.
3. The flash rate shall meet the requirements of UL 1971.

C. Horn/Strobes:
1. Operate on 24 VDC
2. Have two selectable tone options of temporal 3 and non-temporal continuous pattern.

3. Have at least 2 audibility options
4. Maximum Pulse Duration: 0.2 second.
5. Strobe Intensity: UL 1971.
6. Flash Rate: UL 1971.
7. Strobe Candela Rating: Determine by positioning selector switch on back of device.
8. The horn in sleeping areas including the living on all audible fire alarm system appliances shall include a low frequency alarm signal tone that is a square wave (or provide equivalent awakening capability) with a fundamental frequency of 520 hertz ± 10 percent. The system shall include the 520 hertz tone as part of the evacuation notification to comply with sections 18.4.5.3 and 29.3.8 of the NFPA 72. Include additional components as required.

D. Waterflow Indicator:

1. Waterflow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type.
2. Waterflow Switches shall have an alarm transmission delay time which is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds.
3. All waterflow switches shall come from a single manufacturer and series.
4. Waterflow switches shall be provided and connected under this section but installed by the mechanical contractor.
5. Where possible, locate waterflow switches a minimum of one (1) foot from a fitting which changes the direction of the flow and a minimum of three (3) feet from a valve.

E. Sprinkler and Standpipe Valve Supervisory Switches:

1. Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
2. PIV (post indicator valve) or main gate valves shall be equipped with a supervisory switch.
3. The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
4. The supervisory switch shall be contained in a weatherproof aluminum housing, which shall provide a 3/4 inch (19 mm) conduit entrance and incorporate the necessary facilities for attachment to the valves.
5. The switch housing shall be finished in red baked enamel.
6. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.
7. Valve supervisory switches shall be provided and connected under this section and installed by mechanical contractor.

    a. This unit shall provide for each zone: alarm indications, using a red alarm and yellow trouble long-life LEDs and control switches for the control of fire alarm control panel functions. The annunciator will also have an ON-LINE LED, local piezo electric signal, local acknowledge/lamp test switch, and custom slide-in zone/function identification labels.
    b. Switches shall be available for remote annunciation and control of output points in the system, system acknowledge, telephone zone select, speaker select, global signal

silence, and global system reset within the confines of all applicable standards.

F. Alphanumeric LCD Type Annunciator: existing to remain / be relocated.

G. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.

I. Field Wiring Terminal Blocks

For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

2.5. SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices - General

1. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
2. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.
3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.
8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal

decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.

11. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
12. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.
13. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

B. Addressable Manual Fire Alarm Box (manual station)

1. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

C. Intelligent Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

D. Intelligent Thermal Detectors

1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

E. Intelligent Duct Smoke Detector

1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.
2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

F. Advanced Multi-Criteria Intelligent Detector

1. The intelligent multi criteria IntelliQuad detector shall be an addressable device combining four sensing elements in a single sensing device providing the ability to detect all four major elements of a fire. The detector design shall allow sensitivity setting between 1% to 4% per foot obscuration.

2. The detector shall include a photoelectric sensing element, thermal sensing element, IR (Infrared) sensing element and CO (carbon monoxide) sensor.

G. Two Wire Detector Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
2. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
3. For multiple 2-wire smoke detector circuit monitoring a module shall be available that provides 6 Style B or 3 Style D input circuits.

H. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances.
2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with a current rating of 2 Amps for Style Z and 3 Amps for Style Y.
3. Audio/visual power shall be provided by a separate supervised circuit from the main fire alarm control panel or from a supervised UL listed remote supply.
4. For multiple circuit control a module shall be available that provides 6 Style B or 3 Style D control circuits.

I. Addressable Relay Module

1. Addressable Relay Modules shall be available for HVAC control and other network building functions. The module shall provide two form C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary devices energize at the same time on the same pair of wires.
2. For multiple relay control a module shall be available that provides 6 programmable Form-C relays.

J. Isolator Module

1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.
2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
3. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
4. The isolator module shall provide a single LED that shall flash to indicate that the isolator

is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

2.6. BATTERIES:

A. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

C. If necessary to meet standby requirements, external battery and charger systems may be used.

2.7. In House Radio System:

Install a wireless firefighter communications system that is compliant with the requirements of the **City of Providence**

This system shall consist of the following:

1. Amplifiers
2. Antennas and associated wiring
3. Remote annunciator and signage shall be located at the main lobby
4. The amplifier shall be located in a lockable room. Power shall be provided from the house panel as per manufacturer requirements.
5. The EC shall run wiring (2 hour rated or in a 2 hour rated shaft) as per manufacturer requirements.
6. The electrical contractor shall submit on systems components and shop drawings with layout.
7. The system shall be tested as per Providence Fire Department requirements and achieve a minimum of 95dba throughout the building.
8. The citywide coordinated communication system shall have a minimum specification of “Speech understandable without repetition. Some noise and or distortion” – DAQ Level 3.4.
9. 800 MHz Radio. The usable radio signal minimum reliability of the citywide coordinated communication system shall be ninety-five (95) percent in general areas and ninety-nine (99) percent in critical areas.
10. General area. Shall be provided with ninety-five (95) percent floor area radio coverage. These areas include all other areas not specified as a critical area.
11. Critical areas. Shall be provided with ninety-nine (99) percent floor area radio coverage. Critical areas include: the emergency command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the city.
12. Fixed point-to-point microwave radio. Shall be provided with 99.999 percent link availability.
13. Requirements shall comply with Ord. 2008, ch. 08-35 and Article VIII of the City Ordinances.

PART 3.0 - EXECUTION

3.1. INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2. TEST:

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.

A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

C. Verify activation of all waterflow switches.

D. Open initiating device circuits and verify that the trouble signal actuates.

E. Open and short signaling line circuits and verify that the trouble signal actuates.

F. Open and short notification appliance circuits and verify that trouble signal actuates.

G. Ground all circuits and verify response of trouble signals.

H. Check presence and audibility of tone at all alarm notification devices.

I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

J. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3. FINAL INSPECTION:

A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4. INSTRUCTION:

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION

SECTION 310000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials, and equipment necessary to install the generator, transformer, underground utilities, and sidewalk adjustments as shown on the plans, including but not limited to the following.
   1. Excavating, backfilling and compacting the Site as required to complete the Work shown on the Drawings and as specified herein, including selective excavation as required.
   2. Preparing subgrades.
   3. Removal of underground utilities if applicable.
   4. Subbase course for concrete pavements and equipment pads.
   5. Subbase and base course for asphalt paving.
   6. Excavating and backfilling for utility trenches and utility structures.
   7. Coordination and maintenance of safe path of travel for the public.

B. Alternates: Not Applicable.

C. Items To Be Installed Only: Not Applicable.

D. Items To Be Furnished Only: Not Applicable.

E. Related Work: The following items are not included in this Section and will be performed under the designated Sections.
   1. Division 02, 22, 23, and 26 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Course 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. 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. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
   2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Architect. Unauthorized excavation, as well as remedial work directed by the Architect, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement, or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Controlled low-strength material, including design mixture.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
   1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
   2. Laboratory compaction curve according to ASTM D 1557 for each onsite and borrow soil material proposed for fill and backfill.
   3. Test reports for compliance with ASTM D2940 requirements for subbase material.
   4. Particle size Analysis in accordance with ASTM D422.

C. Pre-excavation Photographs and Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused

by earthwork operations. Submit before earthwork begins. Maintain catalog of up-to-date photographs at the site.

D. Plan to Maintain Safe Path of Travel: Submit plans for maintaining safe paths of travel for the general public during the entire project, including requirement for police details of necessary.

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving occupied facilities unless permitted in writing by the Architect and then only after arranging to provide temporary utility services according to requirements indicated.
   1. Notify the facilities not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without written permission.
   3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

1.6 EXAMINATION OF SITE CONDITIONS AND DOCUMENTS

A. It is hereby understood that the Contractor has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions as indicated in the Contract Documents, or obvious from observation at the Site.

B. Plans, surveys, measurements, and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the bidding period, as no allowance will be made for any errors or inaccuracies that may be found except as otherwise provided herein.

1.7 COORDINATION

A. Prior to the start of earthwork, the Contractor shall arrange an onsite meeting with the Architect, and the testing agency for the purpose of establishing the Contractor's schedule of operations, and scheduling observation and testing procedures and requirements.

B. As construction proceeds, the Contractor shall be responsible for notifying the testing agency prior to the start of earthwork operations requiring observation and/or testing.

C. The work of this Section shall be coordinated with that of other trades affecting, or affected by, this work, as necessary to ensure the steady progress of all work of the Contract.

1.8 PERMITS, CODES AND SAFETY REQUIREMENTS

A. Work shall conform to the Drawings and Specifications and shall comply with applicable codes and regulations. Present in writing to the Architect, all conflicts between the Drawings,

Specifications, and applicable codes and regulations, for resolution before commencing the Work.

B. Comply with all local rules, regulations, laws and ordinances and the State of Rhode Island, and of all other authorities having jurisdiction. All labor, materials, equipment, and services necessary to make the work comply with such requirements, shall be provided without additional cost to the Owner.

C. The Contractor shall so conduct his operations as to interfere as little as possible with the use ordinarily made of roads, driveways, sidewalks, or other facilities near enough to the work to be affected thereby.

D. The Contractor shall procure and pay for all permits and licenses required for the complete work specified herein and shown on the Drawings at no additional cost to the Owner. Arrange and pay for legal off-site disposal of all excess excavated materials, obtain proper disposal receipts from the applicable disposal facility for verification.

E. Notify "Dig Safe" and the Owner before starting work; comply fully with utility company requirements.

1.9 LAYOUT AND GRADES

A. The Contractor shall maintain and/or re-establish benchmarks and survey monuments shown on the Contract Drawings or found to exist on the site to provide a base reference for the construction. Replace any that may become destroyed or disturbed. The Contractor shall employ and pay all costs for a registered Land Surveyor who is licensed within the jurisdiction of the project site to lay out all lines and grades in accordance with the Contract Drawings and Specifications, and as necessary or required for the construction.

1.10 DISPOSITION OF EXISTING UTILITIES

A. Active utilities existing on the site shall be carefully protected from damage and relocated or removed by others as specified in the Documents. When an active utility line is exposed during construction, its location and elevation shall be plotted on the record Contract Drawings and both the Architect and Utility Owner notified in writing.

B. Inactive or abandoned utilities encountered during construction operations shall be removed. The location of such utilities shall be noted on the record Contract Drawings and reported in writing to the Architect.

C. In removing existing abandoned utilities within the new building area, the Contractor shall also excavate all associated backfill material and replace with compacted Structural Fill.

1.11 DISPOSAL

A. The Contractor shall re-use on-site excavated soils on-site as Ordinary Fill as indicated below. Solid waste consisting of brick, concrete, asphalt, cobbles, and boulders that measure less than two cubic yards in volume shall become the property of the Contractor and be legally disposed

of off-site at no additional cost to the Owner. Excavated on-site soils which are suitable for re-use at the time of excavation but become frozen or too wet for re-use due to poor material handling practices shall be disposed of off-site and replaced as necessary at no additional cost to the Owner.

B. Solid waste resulting from screening or culling operations shall become the property of the Contractor and be legally disposed of off-site at no additional cost to the Owner.

1.12 MEASUREMENT AND PAYMENT

A. The base bid lump sum price shall include all costs of whatever nature associated with the content of this specification section and earthwork shown on the Contract Drawings including, but not limited to: demolition and removal of existing abandoned utilities and associated structures and appurtenances as indicated on the Contract Drawings, excavation for site improvements, removal of existing subsurface obstructions, segregating and all screening operations, stockpiling, handling and re-use of excavated materials, earthwork for paved areas, utilities, and site improvements, construction dewatering, off-site disposal of all solid waste, placement and compaction of the specified fill materials in accordance with procedures documented herein, loading of all materials to be disposed of off-site and trucking and disposal of all Unregulated soil and solid waste.

B. The Contractor shall include in his lump sum price all costs associated with excavating all existing fill, topsoil, subsoil and natural soil materials down to the surface of the design bearing strata consisting of the natural soil, followed by replacement with compacted fill as specified herein.

C. The Contractor shall include in his lump sum price all costs associated with segregating, culling, and screening operations required for rendering the on-site fill material suitable for reuse on this project as Ordinary Fill material as defined herein.

D. If any part of the excavation is carried through error beyond the depth directed by the Architect and the dimensions indicated on the Contract Drawings, or called for in the Specifications, the Contractor, at his own expense, shall furnish and install compacted Gravel Borrow, Crushed Stone or lean concrete as directed by the Architect up to the required level and/or dimensions.

E. Compensation for all work required under this Section and not specifically covered elsewhere, shall be included in the Contract Lump Sum Price for Earthwork.

1.13 FIELD QUALITY CONTROL

A. The Owner may retain and pay for the services of an independent testing agency to monitor backfill operations and to perform field density tests, and a Geotechnical Engineer to periodically observe the earthwork operations and observe the preparation of the subgrade for paved areas, equipment pads, and utility trenches and structures. The Geotechnical Engineer may from time-to-time request that the contractor excavate tests pits ahead of excavation to confirm subsurface conditions.

B. The Contractor shall make provisions for allowing observations and testing of Contractor’s Work by the Geotechnical Engineer and by the independent testing and inspection firm.

C. Costs related to retesting due to unacceptable quality of work and failures discovered by testing shall be paid for by the Contractor at no additional expense to Owner, and the costs thereof will be deducted by the Owner from the Contract Sum.

D. The Owner's Geotechnical Consultant's and/or Testing Agency's presence does not include supervision or direction of work by the Contactor, his/her employees, or agents. Neither the presence of the Owner's Geotechnical Consultant and/or Testing Agency nor any observations performed by him/her, or any notice or failure to give notice, shall excuse the Contractor from deficiencies in the work.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide soil materials when sufficient satisfactory soil materials are not available from on-site excavations.

B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
2. Onsite material for use in compacted fill shall be natural inorganic granular soil taken from areas of cut after removal of pavement, topsoil, or other unsuitable materials. Onsite materials should be tested for compliance with the specifications before placement. Onsite materials with less than 40 percent fines and with maximum particle size of 6 inches or less can be reused. Onsite materials that do not meet the gradation requirements of the specification should be used in landscaped areas, relocated onsite if directed by the Owner, or disposed of offsite.

D. Ordinary Fill shall consist of inert, hard, durable sand and gravel, free from ice and snow, organic matter, clay, surface coatings, and deleterious materials, and shall have a plasticity index of less than 6. Ordinary fill shall be placed in 12-inch loose lifts and shall conform to the following gradation requirements:

Sieve Size	Percent Passing by Weight
6-inches	100
1-inch	50-100
No. 4	20-100
No. 20	10-70
No. 60	5-45
No. 200	0-20

E. Subbase Material: Processed Gravel for subbase shall be naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand, meeting the requirements of RIDOT Processed Gravel for Subbase, Section M.01.10.

Sieve Size	Percent Passing By Weight
3 inches	100
1-1/2 inches	70-100
3/4 inch	50-85
No. 4	30-60
No. 200	0-10

F. Crushed Stone shall consist of durable crushed rock or durable crushed gravel stone, free from ice and snow, sand, clay, loam, or other deleterious material, conforming to RIDOT, Section M.01.09, size as indicated on Drawings. Crushed stone shall be uniformly blended and conform to the following gradation requirements.

	Percent Passing by Weight		
Sieve Size	1/2-Inch Stone	3/4-Inch Stone	1.5-Inch Stone
2 inches	100	100	100
1-1/2 inch	100	100	95-100
1 inch	100	100	35-70
3/4 inch	100	90-100	0-25
5/8 inch	100	---	---
1/2 inch	85-100	10-50	---
3/8 inch	15-45	0-20	---
No. 4	0-15	0-5	---
No. 8	0-5	---	---

G. Dense Graded Crushed Stone for base course shall be naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand, consisting of angular material, that is hard, durable and free from clay, loam or other plastic material. Gradation shall conform to RIDOT Specification Designation, M.01.09, and the following:

Sieve Size	Percent Passing by Weight
2 inches	100
1-1/2 inches	70-100
3/4 inch	50-85
No. 4	30-55
No. 50	8-24
No. 200	3-10

H. Sand shall consist of clean inert, hard, durable grains of quartz or other hard durable rock, free from clay, organics, surface coatings or other deleterious material, confirming to RIDOT Section M.01.08. Sand shall conform to the following gradation:

Sieve Size	Percent Passing by Weight
1/2-inch	100
3/8-inch	85-100
No. 4	60-100
No. 16	35-80
No. 50	10-55
No. 100	2-10

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; 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.

2.3 USE OF MATERIALS

A. Use of materials shall be as described below and as shown in the Drawings.

B. Ordinary Fill: Use Ordinary Fill as general site fill outside of the new building footprint area for embankments, landscaping, and beneath Processed Gravel for Subbase in paved areas where specified material such as Crushed Stone, Structural Fill, Crushed Stone and Sand are not indicated.

C. Crushed Stone - Use crushed stone as indicated on the Drawings.

D. Processed Gravel - Use for Subbase under paved areas.

E. Dense Graded Crushed Stone - Use for base under paved areas.

F. Sand – Use sand for bedding for utility bedding, setting bed for concrete block pavers, and as indicated elsewhere on the drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Prepare subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area. Dispose of contaminated water in accordance with regulations of authorities having jurisdiction.

B. 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.
   2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 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. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
   2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
      a. 24 inches outside of concrete forms other than at footings.
      b. 12 inches outside of concrete forms at footings.
      c. 6 inches outside of minimum required dimensions of concrete cast against grade.
      d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
      e. 6 inches beneath bottom of concrete slabs on grade.
      f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR CONCRETE PADS

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch 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. Excavation for Underground Tanks, Manholes, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
   1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: 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.
   1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
   2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
   3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

A. Notify Geotechnical Engineer when excavations have reached required subgrade.

B. If Designer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
   2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Designer, and replace with compacted backfill or fill as directed.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Designer, without additional compensation.

3.9 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 may be used when approved by Designer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Designer.

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.
   2. Stockpile soil materials in a location, acceptable to the facility, that will preclude having to relocate stockpiled soil materials that would otherwise delay or impact the Work.

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, dampproofing, 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 and 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.

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 indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings.

D. Place and compact initial backfill of subbase material free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

E. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

F. Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal 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.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.
   5. Under footings and foundations, use engineered fill.

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. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
   1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent; and areas within 10 feet of structures, building slabs, steps, and pavements at 92 percent.
   2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
   3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
   4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.16 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 Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus, or minus 1 inch.
   2. Walks: Plus, or minus 1 inch.
   3. Pavements: Plus, or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
   1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
   2. Place base course material over subbase course under hot-mix asphalt pavement.
   3. Shape subbase and base course to required crown elevations and cross-slope grades.
   4. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
   5. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   6. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.18 FIELD QUALITY CONTROL

A. Independent Testing Agency: Cooperate with the Independent Testing Agency engaged by the facility for field quality control activities for the Work of this Section. Refer also to Section 01 43 25 - TESTING AGENCY SERVICES.

B. Cooperate with field quality control personnel.

C. Additional inspections and retesting of materials which fail to comply with specified material and installation requirements shall be performed at Contractor's expense.

D. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
   1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
   2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

F. 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 to depth required; recompact and retest until specified compaction is obtained.

G. Notify the Independent Testing Agency a minimum of 72 hours prior to start of earthwork operations, to comply with Code requirement that a registered design professional be present at all times during backfill to assure adequate compaction with no bridging effects.

3.19 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 Designer; 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.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the User Agency's property.

END OF SECTION 310000

SECTION 312300.01 INTERIOR FILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. The work of the Section consists of providing fill at the former interior swimming pool and new interior slab on grade , but is not necessarily limited to, the following:
   1. Providing, placing and compacting fill materials.
   2. Rough grading.

1.3 ACTION SUBMITTALS

A. Issue submittals in accordance with Division 1. Submittals under this Section shall include manufacturer's specifications and installation instructions.

1.4 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For proposed fill and backfill as follows:
   1. Classification according to ASTM D2487.
   2. Laboratory compaction curve according to ASTM D1557

1.5 TESTING

A. The Owner will retain a Testing Agency to perform on-site observation and testing during the construction operations. The Contractor shall coordinate the individual's required presence on the site with the Clerk/OPM and the construction activities. The services of the shall include the following:
   1. Field testing to assess degree of compaction.
   2. Laboratory testing and analysis of fill materials specified, as required.

B. The Testing Agency's presence does not include supervision or direction of the actual work by the Contractor, his employees, or agents. Neither the presence of the Testing Agency nor any observations and testing performed by their representatives, nor any notice or failure to give notice, shall excuse the Contractor from defects discovered in the Work.

C. The Contractor shall provide a 50-pound sample of each fill material from each proposed source of supply. The Contractor shall include the name of the source and identify the specification item for which the material is proposed. Allow sufficient time for testing and evaluation of results before materials are needed. Once a source of supply for a specific material has been

accepted for use on the project, the Contractor will bear the cost of testing for any additional materials submitted for the same use. This also includes the event where the gradation of the material within the source changes.

D. Architect will be sole and final judge of suitability of all material.

E. The Testing Agency will determine the maximum modified dry density and optimum water content of fill materials in accordance with ASTM D1557, Method D, and the in-place density in accordance with ASTM D6938

F. Tests of materials as delivered may be made from time to time. Materials in question shall not be used pending test results. The Contractor shall remove and legally dispose of off-site all rejected materials and replace with new, whether in stockpiles or in-place.

G. The Contractor shall bear the cost of testing materials that fail to conform to the Specifications.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. Fill materials shall conform to the following material descriptions. Gradation requirements shall be determined by ASTM D2487 unless specified otherwise.

B. All material shall be well graded between the gradation limits shown.

C. Structural Fill: Well-graded natural sand and gravel free from clay, organic matter, surface coatings, or other deleterious materials conforming to following gradation:
1.

Opening or Sieve No.	Percent Passing by Weight
3 inches	100
1/2 inch	50-100
No. 4	35-85
No. 16	20-65
No. 50	5-40
No. 200	0-8

D. Crushed stone shall consist of inert angular material derived from a stone quarry that is hard, durable, washed stone, free of deleterious materials.

U.S. Sieve No.	Percent Finer by Weight	Percent Finer by Weight
1"	100	35-70
3/4"	90-100	0-25

2.2 GEOTEXTILE AT ABANDONED DRAINS AND BELOW CRUSHED STONE

A. Geotextile Fabric shall consist of Mirafi FW700 or approved equal.
   1. A woven geotextile composed of polypropylene fibers, formed into a stable network such that the fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids. Fabric must meet AASHTO M288-06 Class 3 for Elongation > 50%.

2.3 USE OF MATERIALS

A. Fill materials listed above shall be utilized as follows and as otherwise indicated on the Drawings, specified or directed.
   1. Structural Fill
      a. At existing indoor pool tank
      b. Beneath new slabs on grade
   2. Crushed Stone
      a. Beneath multi-purpose room slab on grade

2.4 EQUIPMENT

A. Compaction equipment shall consist of power-driven vibratory equipment and/or hand-guided mechanical tampers as approved by the Architect and capable of achieving the required degree of compaction in a reasonable length of time.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. The Drawings indicate, in general, alignments, grade elevations and invert elevations. Establish the lines and grades in conformity with the Drawings. The Architect, however, may make such adjustments in the field in grades and alignments as are found necessary in order to avoid interference with any special conditions encountered.

3.2 FILLING AND COMPACTION

A. Provide material conforming to these specifications and referenced Standards for all additional required fill at no additional cost to the Owner if sufficient quality or quantity of suitable material is not available on site.

B. Finished grades not otherwise indicated shall be uniform levels or slopes between points where levels are given or between such points and existing finished grades.

C. All areas to be filled or backfilled shall be free of construction debris, refuse, compressible or decayable materials and standing water. Do not place fill when materials or material below it is frozen. No fill material containing ice or frozen lumps shall be used.

D. Material shall be placed in evenly distributed horizontal layers over entire area, spread and compacted as specified.
   1. Remove all debris, organic materials or otherwise unsuitable materials from areas to be backfilled or filled.
   2. Deposit fill in successive layers having a loose lift thickness not more than 6-inches for hand operated equipmen. Each layer shall be moistened and thoroughly compacted by roller, pneumatic tamper, or other approved method.
   3. Moisture-density determinations shall be performed on representative soil samples in accordance with ASTM D1557, Method D.
   4. Field density tests shall be taken in accordance with ASTM D6938. The following percentages of maximum dry densities shall be achieved for fill materials or prepared subgrades.
      a. Under structures, footings, paved surfaces, drainage piping, utilities and other improvements:
         1) All fills 95%
         2) Top twelve inches of subgrades in cut 95%

E. Filling shall be done only after the area to be filled has been observed by the Architect. The Contractor shall notify the Architect when excavation is ready for formal inspection. All areas to receive fill shall be proof-rolled by at least two passes of the compaction equipment to be utilized for controlled placement of compacted fill, or other approved equipment.

F. Testing Requirements:
   1. One test per lift at fill.

END OF SECTION 312300.01

SECTION 320190 – LAWN RESTORATION

PART 1 - GENERAL

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 lawn renovation of areas disturbed by construction operations.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

1.6 SCHEDULING

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: State-certified seed of grass species, Proportioned by weight as follows:
1. 50 percent Kentucky bluegrass (Poa pratensis).
2. 30 percent chewings red fescue (Festuca rubra variety).
3. 10 percent perennial ryegrass (Lolium perenne).
4. 10 percent redtop (Agrostis alba).

2.2 TOPSOIL

A. Topsoil stripped and stockpiled on the site may be used provided that, after testing and addition of necessary additives, it meets the following specifications.

B. Provide all additional topsoil required for the work of this Section from approved off-site sources. Review geotechnical investigations and other such reports and determine the quantity of topsoil required for completion of work under this Section. Provide topsoil for seeding of all disturbed areas within or outside the Limit of Work line.

C. Topsoil: Shall be a natural friable, fertile soil characteristic of productive soils in the vicinity. It shall be of uniform composition, without admixture of subsoil. It shall be free of stones greater than one inch, lumps, plants and their roots, debris, clay and other extraneous matter. It shall not contain toxic substances harmful to plant growth. It shall not contain toxic substances harmful to plant growth. It shall be obtained from naturally well drained areas which have never been stripped before and have a history of satisfactory vegetative growth.

D. Topsoil shall have an acidity range of pH 5.8 to pH 7.0 and shall contain not less than 4% nor more than 20% organic matter as determined by the loss of ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 2300° F plus or minus 9 degrees.

E. Make any and all additions to or amendments of topsoil as required to remedy any deficiency shown in these tests.

F. No topsoil shall be delivered in a frozen or muddy condition.

2.3 TOPSOIL ADDITIVES AND OTHER MATERIALS

A. Compost: Shall be mature, stable, weed free, and produced by aerobic decomposition of organic matter. Compost feedstock may include, but is not limited to: agricultural, food or industrial residuals; class A biosolids as defined in the EPA CFR Title 40, Part 503; yard trimmings, or source-separated municipal solid waste. The product must not contain any

visible refuse or other physical contaminants, substances toxic to plants, or over 5% sand, silt, clay or rock material by dry weight. The product shall possess no objectionable odors. The product must meet all applicable USEPA CFR, Title 40, Part 503 Standards for Class A biosolids. The moisture level shall be such that no visible water or dust is produced when handling the material.

B. Commercial Fertilizer: Shall be complete fertilizer and shall be a standard product complying with State and United States fertilizer laws. Fertilizer shall be delivered to the site in original unopened containers which shall bear the manufacturer's name and guaranteed statement of analysis. At least 50 percent by weight of the nitrogen content of the fertilizer shall be derived from organic materials. Fertilizer shall be a slow-release fertilizer with equal portions of nitrogen, phosphorus, and potassium by weight of ingredients or as otherwise indicated by topsoil test results. NOTE: Fertilizer shall **not** be used in conjunction with the disturbed area seed mix unless recommended by soil testing.

C. Superphosphate: Shall be finely ground phosphate rock as commonly used for agricultural purposes and shall contain not less than 18 percent available phosphoric acid.

D. Ground Limestone: Shall be dolomitic limestone, shall contain not less than 85 percent of total carbonates and magnesium; and shall be ground to such fineness that 50 percent will pass a 100 mesh sieve and 90 percent will pass through a 20 mesh sieve. Coarser material will be accepted provided the specified rates of application are increased proportionately on the basis of quantities passing the 100-mesh sieve.

E. Water: Will be furnished by the Owner at existing hydrants, and shall be suitable for irrigation and free from ingredients harmful to plant life. Hose and all other watering equipment required for the work shall be furnished under this Section.

2.4 WOOD FIBER MULCH FOR HYDROSEEDING

A. Shall consist of virgin wood fiber mulch from 100% whole wood chips. 30% of the fibers shall average 0.15 inches (3.7mm) or longer and with 50% or more retained on a Clark Fiber Classifier 24-mesh screen. The fibers shall be colored green with water-soluble non-toxic dye to help the applicator apply slurry uniformly. The dye will not stain masonry, concrete, asphalt or painted surfaces. Acceptable products are Conwed Hydro Mulch® Fibers, as manufactured by Conwed Fibers Division, St. Paul, MN, Terra-Mulch, as manufactured by Profile Products LLC, Buffalo Grove, IL, or Silva Fiber®, as manufactured by Weyerhauser Company, Tacoma, WA

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas requiring restoration of lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LAWN RENOVATION/REPAIR

A. Renovate existing lawn damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

B. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury in soil.

C. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.

D. Mow, de-thatch, core aerate, and rake existing lawn.

E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).

H. Apply soil amendments and initial fertilizers required for establishing new lawns and mix thoroughly into top 4 inches (100 mm) of existing soil. Provide new planting soil to fill low spots and meet finish grades.

I. Apply seed and protect with straw mulch as required for new lawns.

J. Water newly planted areas and keep moist until new lawn is established.

3.4 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

C. Remove erosion-control measures after grass establishment period.

END OF SECTION 320190

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials, and equipment necessary to install the generator, transformer, underground utilities, and sidewalk adjustments as shown on the plans, including but not limited to the following.
   1. Hot-mix asphalt paving, including walkways, ramps, and curbs.
   2. Hot-mix asphalt patching.

B. Alternates: Not Applicable.

C. Items To Be Installed Only: Not Applicable.

D. Items To Be Furnished Only: Not Applicable.

E. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
   1. Section 310000 - EARTH MOVING for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
   1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

B. Material Certificates: For each paving material, from manufacturer.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements for hot mix asphalt paving work in the State of Rhode Island.
   1. Comply with the requirements of the RIDOT including supplemental specifications and special provisions.

2. Comply with requirements of the Americans with Disabilities Act (ADA) and Rhode Island's Commission on Disabilities. If these requirements cannot be met with the grades and slopes indicated on the plans, notify the Designer immediately.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.
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 plant that will manufacture hot-mix asphalt.
b. Review condition of subgrade and preparatory work.
c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. 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. Tack Coat: Minimum surface temperature of 60 deg F.
2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

B. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

C. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

D. Reclaimed Asphalt Pavement (RAP): Provide material obtained from the highways or streets by crushing, milling, or planing existing hot mix asphalt pavements.
   1. The proportion of RAP to virgin aggregate for base course mixtures and intermediate course mixtures shall be limited to a maximum of 40% for drum mix plants and 20% for modified batch plants. The maximum amount of RAP for surface course mixtures shall be 10%.

2.2 ASPHALT MATERIALS

A. Asphalt Binder Performance Graded: AASHTO M320 or AASHTO MP 1a, performance grade as required by RIDOT Specifications.

B. Tack Coat: AASHTO M 140 emulsified asphalt, or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

2.4 ASPHALT MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by RIDOT Specifications, HMA Binder for binder courses, HMA Surface Standard Top for surface courses, and MHW 3/8” Top for sidewalks, designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

3.3 PATCHING

A. Existing Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Existing Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
   1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a minimum rate of 0.05 to 0.15 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.

D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 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.

3.5 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to 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. Spread mix at minimum temperature of 250 deg F.
   2. 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 wide unless infill edge strips of a lesser width are required.

C. 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.

3.6 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.
   3. Offset transverse joints, in successive courses, a minimum of 24 inches.
   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 according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.7 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.
   1. Complete compaction before mix temperature cools to 185 deg F.

B. 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.

C. 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: ASTM D 2041, per RIDOT Specifications.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. 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.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

A. Accessibility: Comply with requirements of ADAAG and Rhode Island Commission on Disabilities. Remove and replace paving that does not meet required tolerances, when measured with a 2-foot straightedge.

B. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
   1. Base Course: Plus or minus 1/2 inch.
   2. Surface Course: Plus 1/4 inch, no minus.

C. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within RIDOT Specification tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas.

3.9 FIELD QUALITY CONTROL

A. Independent Testing Agency: Cooperate with the Independent Testing Agency engaged by the facility for field quality control activities for the Work of this Section.

B. Test the plane of the finished surfaces of base, binder, and surface courses with a 16-foot straightedge, except use a 10-foot straightedge on vertical courses and on the top course of resurfaced streets which contain manhole covers, valve boxes, and the like.

C. Carefully apply the straightedge immediately after the first compaction by rolling, and from then on as may be necessary until and after the final compaction of the material in place. Hold the straightedge in successive positions parallel to the road centerline and in contact with the road surface; check the entire area from one side of the pavement to the other.

D. Correct irregularities which vary 3/8 inch from a true finished surface in base and binder courses, and 1/4 inch in top courses.

E. Irregularities which may develop before the completion of rolling and while the material is still workable, may be remedied by loosening the surface mixture and removing or adding material as necessary. Should any unsatisfactory irregularities or defects remain after final compaction, correct the defective work by removing and replacing with new material to form a true and even surface.

3.10 OPENING TO TRAFFIC

A. No vehicular traffic or loads shall be permitted on the newly completed pavement until adequate stability has been attained, and the material has cooled sufficiently to prevent distortion or loss of fines, and the pavement has achieved a maximum temperature of 140 degrees F.

B. If the climatic or other conditions warrant it, the period of time before opening to traffic may be extended at the discretion of the Architect.

3.11 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 321216

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SECTION 323300 - SITE IMPROVEMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Bicycle racks.
   2. Accessible Building Entry Sign
   3. Metal Landscape Edging where indicated on the drawings
   4. Metal plate at modified site wall opening Detail 7 on Sheet A004.

B. Coordinate work sign and metal plate work with Section 101416 Plaques .

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 BICYCLE RACKS

A. Bicycle Rack Construction: U-Bike Rack
   1. Frame: Stainless steel.
      a. Tubing OD: Not less than 1 7/8 inch diameter.
      b. Thickness: 11-gage.
   2. Style: Double-side parking
      a. Overall Height: 36-inches
      b. Overall Width: 22-inches
   3. Installation Method: Cast in concrete.

B. Stainless Steel Finish: ASTM A480/A480M, No. 4

2.2 ACCESSIBLE BUILDING DIRECTION SIGN

A. Cast Sign: Cast-metal Sign with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
   1. Sign Material: bronze.
   2. Sign Thickness: 0.50 inch.
   3. Finishes:
      a. Integral Metal Finish: Mill finish raised surface with dark oxidized background.
      b. Overcoat: Manufacturer's standard baked-on clear coating

B. Design Intent: 8 by 8 inch with concealed mounting.

C. 

Final design to be determined.

2.3 METAL EDGE PLATE

A. End plate on wall at new site wall openings:
   1. Plaque Material: Sheet or plate bronze.
   2. Plaque Thickness: ½ inch thick.
   3. Finishes: Mill Finish with baked on clear coating.
   4. Mounting: concealed

2.4 LANDSCAPE EDGINGS

A. Steel Edging: Standard commercial-steel edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.
   1. Edging Size: 1/4 inch (6.4 mm) thick by 5 inches (125 mm) deep
   2. Stakes: Tapered steel, a minimum of 12 inches long.
   3. Accessories: Standard tapered ends, corners, and splicers.
   4. Finish: Manufacturer's standard paint.
      a. Paint Color: Black

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF BIKE RAKE

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

C. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

3.3 INSTALLATION OF METAL SIGN AND END PLATES

A. General: Install Signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install Signs level, plumb, true to line, and at locations and heights indicated, with Sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that Sign surfaces are clean and free of materials or debris that would impair installation.

3.4 INSTALLATION OF LANDSCAPE EDGINGS

A. Steel Edging: Install steel edging where indicated in accordance with manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches (760 mm) apart, driven below top elevation of edging.

END OF SECTION 323300

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SECTION 329300 – PLANTS (ALLOWANCE)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Base Contract Work
      a. Soil for in-ground planting
      b. Fertilizers.
      c. Weed-control barriers.
      d. Mulches.
      e. Herbicides and pesticides.
      f. Tree-stabilization materials.
   2. Allowance Work:
      a. Planting Material and installation
      b. Soil for raised planting beds
      c. Raised Planting Bed Structures

1.2 ALLOWANCES

A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:
   1. Plant materials.
   2. Soil for in ground planting
   3. Fertilizers.
   4. Weed-control barriers.
   5. Mulches.
   6. Herbicides and pesticides.
   7. Tree-stabilization materials.

B. Product Data Submittals: For each product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with manufacturer's certified analysis of standard products.

C. Pesticides and Herbicides: Product label and manufacturer's written application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
   1. Pesticide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

   1. Do not dump or store bulk materials near structures, utilities, or walkways and pavements; or on existing turf areas or plants.
   2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk materials with appropriate certificates.

C. Deliver bare-root stock plants within [24 hours] [36 hours] <Insert time> of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.

G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting:
   a. Deciduous material: March 31 through May 1
   b. Evergreen material: April 15 through June 1.
2. Fall Planting:
   a. Deciduous material: October 1 through December 1
   b. Evergreen material: August 15 through October 15.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions in accordance with manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
   a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
   b. Structural failures, including plantings falling or blowing over.

2. Warranty Periods: From date of Substantial Completion.
   a. Trees, Shrubs, Vines, and Ornamental Grasses: Twelve [12] months.
   b. Ground Covers, Biennials, Perennials, and Other Plants: Twelve [12] months.

c. months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

A. TBD -Material Allowance

2.2 RAISED PLANTING BED STRUCTURES

A. TBD- Fabricated or field built structures

2.3 SOIL FOR PLANTING

A. GENERAL USE Loam borrow shall be one of the following loamy sands and sandy loams; “loamy sand”, “loamy fine sand”, “loamy very fine sand”, or “coarse sandy loam”: determined by mechanical analysis (ASTM D 422) and based on the "USDA Classification System" and as defined in this Section. It shall be of uniform composition, without admixture of subsoil. It shall be free of stones greater than 0.75 inches (19 mm) lumps, plants and their roots, debris and other extraneous matter as determined by the Architect.

B. Planting soil for lawn areas shall have the following grain size distribution for material passing the #10 (2.0 mm) sieve:

Millimeter	Percent Passing by Weight	
	Maximum	Mini-mum
2	-------	100
1	100	82
0.5	87	65
0.25	72	49
0.10	45	30
0.05	32	22
0.002	5	2

1. Maximum size shall be one and one quarter inches largest dimension. The maximum retained on the #10 sieve shall be 25% by weight of the total sample.
2. The ratio of the particle size for 80% passing (D80) to the particle size for 30% passing (D30) shall be 6.0 or less. (D80/D30 < 6.0).
3. In addition to the foregoing, all loam borrow to be used for loaming and seeding shall be mechanically screened processed loam borrow that passes a 3/4 inch by 6 inch (19 mm by 150 mm) screen size.

C. Organic content and pH for specific planting use shall be as follows:
1. Areas planted with turf grasses per the Section 32 92 19, SEEDING, of this Specification:
a. pH: 6.0 through 7.0
b. Organic Content 4.0 - 6.0 percent as determined by the loss on ignition of oven-dried samples passing #10 sieve (Muffle furnace temperature: 450 +/- 10 degrees C for 8 hours)

D. Top 18 inches (450 mm) of areas planted with shrubs.
1. pH: 5.5 through 6.5 for non-acid loving plants
2. pH: 4.5 through 5.5 for *Ericaceae* and other acid-loving plants
3. Organic Content 4.0 - 6.0 percent as determined by the loss on ignition of oven-dried samples passing #10 sieve (Muffle furnace temperature: 450 +/- 10 degrees C for 8 hours)

E. Loam borrow shall be pH adjusted for particular planting applications and shall be adjusted prior to delivery to the Project sites as recommended by University of Rhode Island Gardening Information and Soil Testing (GIST) or equivalent testing service.
1. When pH of loam borrow is equal to or greater than 7 use aluminum sulfate to adjust pH downward to required levels.
2. When pH of loam borrow is less than 7 use either sulfur or ferrous sulfate to adjust pH downward to required levels.
3. When pH of loam borrow must be raised to the required levels use limestone.
4. Regardless of amendment Contractor chooses to use, Contractor, not the Owner, shall be responsible for obtaining specified pH by seeding and/or planting time.

F. All loam borrow proposed for use shall be tested for conformance to the specifications. Soil additives shall be used to counteract soil deficiencies as recommended by the soils analysis and as supplements for lawn construction as specified herein.

2.4 FERTILIZERS

A. Granular Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition:
a. 0.75 lb/1000 sq. ft.3 percent of actual nitrogen, 4 percent phosphorous, and 3 percent potassium, by weight.
b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb (0.45 kg) of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb (0.45 kg) of ectomycorrhizal fungi, 33 percent hydrogel, and maximum of 5.5 percent inert material.

2.5 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. (101 g/sq. m) minimum, composed of fibers inert to biological degradation and naturally resistant to chemicals, alkalis, and acids, formed into a stable network so that fibers retain their relative position.

2.6 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded pine and bark chips.
2. Size Range: 3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum.
3. Color: Natural.

2.7 HERBICIDES AND PESTICIDES

A. that has already germinated.

B. Pesticides: Registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended in writing by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.8 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood or softwood with specified wood pressure-preservative treatment], free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.
2. Guys and Tie Wires: ASTM A641/A641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch (2.7 mm) in diameter.
3. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove soil and contamination as directed by Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

3.3 EXCAVATION FOR TREES AND SHRUBS

A. Provide planting Pits and Trenches: Excavate circular planting pits.

B. Backfill Soil: Subsoil and topsoil removed from excavations may[not] be used as backfill soil unless otherwise indicated.

C. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.4 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball in accordance with ANSI Z60.1. If root flare is not visible, remove soil in a level manner from root ball to where the top-most root emerges from the trunk. After soil removal to expose root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches (50 mm) above adjacent finish grades.
   1. Carefully remove root ball from container without damaging root ball or plant.
   2. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
   3. Distribute granular fertilizer around each planting pit when pit is approximately one-half filled. Do not place in bottom of the hole.
   4. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.5 INSTALLATION OF TREE-STABILIZATION MATERIALS

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:
   1. Upright Staking and Tying:
      a. Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches (450 mm)

below bottom of backfilled excavation and to extend one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

3.6 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.7 INSTALLATION OF MULCHES

A. Install weed-control barriers before mulching in accordance with manufacturer's written instructions. Completely cover area to be mulched, overlapping edges minimum of 6 inches (150 mm)] [12 inches (300 mm)], and secure seams with galvanized pins.

3.8 APPLICATION OF HERBICIDES AND PESTICIDES

A. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written instructions. Do not apply to seeded areas.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written instructions.

C. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and in accordance with manufacturer's written instructions. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

3.9 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

3.10 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

END OF SECTION 329300

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SECTION 33 05 13 - MANHOLES AND STRUCTURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

B. The General Contractor shall either perform the work of this section with its own forces or shall subcontract such work to a subcontractor who will furnish a performance and payment bond for the complete scope of work and listing the Owner as the co-oblige. Such bond shall be procured from a surety that is currently licensed to do business in Rhode Island and is currently listed on the United States Treasure Department circular 570. A copy of such bond shall be submitted to the Owner's Project Manager for approval and shall be in place prior to the subcontractor commencing any work on the project.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:
   1. Install precast concrete manholes, frames and covers, manhole rungs, platforms, and appurtenances all as shown on the Drawings and as specified herein.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
   1. Section 31 00 00 - EARTH MOVING
   2. Section 33 41 00 - STORM UTILITY DRAINAGE PIPING

1.3 REFERENCES

A. American Concrete Institute:
   1. ACI 318 - Building Code Requirements for Structural Concrete.
   2. ACI 530/530.1 - Building Code Requirements for Masonry Structures and Specifications for Masonry Structures.

B. ASTM International:
   1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
   2. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
   3. ASTM C32 - Standard Specification for Sewer and Manhole Brick
   4. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   5. ASTM C55 - Standard Specification for Concrete Brick.

6. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
7. ASTM C150 - Standard Specification for Portland Cement
8. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes
9. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
10. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
11. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
12. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
13. ASTM D4097 - Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks
14. ASTMD4101 - Standard Specification for Propylene Plastic Injection and Extrusion Materials

C. American Association of State Highway and Transportation Officials (AASHTO)

D. Occupational Safety and Health Administration (OSHA)

1.4 DESIGN REQUIREMENTS

A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.

B. Design of Lifting Devices for Precast Components: In accordance with ASTM C913.

C. Design of Joints for Precast Components: In accordance with ASTM C913; maximum leakage of 0.025 gallons per hour per foot of joint at 3 ft. of head.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate manhole locations, elevations, and sizes and elevations of penetrations.

C. Product Data: Submit cover and frame construction, features, configuration, dimensions.

1.6 QUALITY ASSURANCE

A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer or other representative of the Owner. Such inspection may be made at the place of manufacture, or on the work after delivery, or at both places and the materials shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein; even though samples may have been accepted as satisfactory as the place of manufacture. Material reject after delivery to the job shall be marked for identification and shall be removed from the job at one. All materials that have been damaged after delivery shall be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor’s expense.

B. At the time of inspection, the materials will be carefully examined for compliance with the applicable ASTM standard specification and this Section with the approved manufacturer's drawings. All manhole sections shall be inspected for general appearance, dimension, scratch strength, blisters, cracks, roughness, soundness, and other surface or structural imperfections. The surface shall be dense and close-textured.

C. Imperfections in manhole sections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at seven days and 5,000 psi at 28 days, when tested in 3-inch x 6-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.8 DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 - PRODUCT REQUIREMENTS: Product storage and handling requirements.

B. Comply with precast concrete manufacturer's instructions for unloading, storing, and moving precast manholes.

C. Store precast concrete manholes to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.

D. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - PRODUCT REQUIREMENTS.

B. Maintain materials and surrounding air temperature to minimum 50 degrees F prior to, during, and 48 hours after completion of masonry work.

C. Cold Weather Requirements: ACI 530.

PART 2 – PRODUCTS

2.1 PRECAST CONCRETE MANHOLE SECTIONS

A. Precast concrete barrel sections and transition top sections shall conform to ASTM C478 and meet the following requirements:

1. Manholes shall have a minimum 48-inch interior diameter with a wall thickness of not less than 5 inches.
2. Top sections shall be eccentric except that barrel sections shall be used where shallow pipe cover requires a top section less than 4 feet.
3. Barrel sections shall have tongue and groove joints. Manholes shall be manufactured in the configuration shown on the Drawings with the bell of the manhole section pointing down.
4. All sections shall be cured by an approved method and shall not be shipped or subjected to loading until the concrete compressive strength has attained 3,000 psi and not before five days after fabrication or repair, whichever is longer.
5. Precast concrete barrel sections with top slabs and precast concrete transition sections shall be designed for a minimum of HS-20 loading plus the weight of the soil above at 120 pcf.
6. The date of manufacture and the name and trademark of the manufacturer shall be clearly marked on the inside of each precast section.
7. Precast concrete bases shall be constructed of and installed as shown on the Drawings. The thickness of the bottom slab of precast bases shall not be less than the manhole barrel sections or top slab, whichever is greater.
8. Knockout panels shall not be permitted.

2.2 BRICK MASONRY.

A. The bricks shall be good, sound, hard and uniformly burned, regular and uniform in shape, of compact size and texture and satisfactory to the Engineer. Underburned or salmon brick will not be acceptable and only whole brick shall be used unless otherwise permitted. In case bricks are rejected by the Engineer, they shall be immediately removed from the site of the work and satisfactory bricks used thereafter.
   1. Bricks for the channels and sleeves shall comply with ASTM C32 for sewer brick; Grade SS (from clay or shale) except that the mean of five tests for absorption shall not exceed 8% and no individual brick shall exceed 11%.
   2. Bricks for building up and leveling the manhole frames shall comply with ASTM C62.

B. Mortar used in the brickwork shall be composed of one part Type II Portland cement conforming to ASTM C150 and sand to which a small amount of hydrated lime not to exceed 10 lbs. to each bag of cement shall be added.

C. The sand used shall be washed, cleaned, screened, sharp and well graded as to different sizes and with no grain larger than will pass a No. 4 sieve. It shall be free from vegetable matter, loam, organic or other materials of such nature or quantity to render it unsatisfactory.

D. The hydrated lime shall also conform to ASTM C207.

2.3 FRAMES, COVERS AND GRATES

A. Manufacturers:
   1. All manufacturers producing such products shall be considered.
   2. Substitutions: Section 01 60 00 - PRODUCT REQUIREMENTS.

B. Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind that render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 35, H-20 loading.

C. Manhole covers shall have a diamond pattern, pick holes, and the word 'DRAIN', cast in 2 in. letters.

2.4 JOINTING PRECAST MANHOLE SECTIONS

A. Tongue and groove joints shall be sealed with either a round rubber o-ring gasket or a preformed flexible joint sealant. The o-ring shall conform to ASTM C443.

B. Joints shall be designed and manufactured so that the completed joint will withstand an internal water pressure of 10 psi without leakage or displacement of the gasket or sealant.

2.5 MANHOLE RUNGS

A. Manhole rungs shall conform to the requirements of ASTM C478 and be of the following types:
   1. Manhole rungs shall be steel reinforced copolymer polypropylene plastic. Rungs shall be 14 inches wide. Copolymer polypropylene shall conform to ASTM D4101. Steel reinforcing shall be 1/2-inch diameter, grade 60 conforming to ASTM A615 and shall be continuous throughout the rung. The portion of the legs to be embedded in the precast section shall have fins and be tapered to insure a secure bond.

2.6 PIPE CONNECTION TO MANHOLE

A. Manhole pipe connections may be accomplished in the following ways:
   1. The 'Lock Joint Flexible Manhole Sleeve' shall be cast in the precast manhole base. The steel strap shall be protected from corrosion with a bituminous coat.
   2. 'A-Lok' shall be a rubber like gasket cast in the precast manhole base. The rubber gasket shall be case into a formed opening in the manhole.
   3. 'Kor-N-Seal' joint shall be installed as recommended by the manufacturer. The stainless-steel clamp shall be protected from corrosion with a bituminous coat.

B. Clear Cover Opening: 24-inch diameter, or as otherwise indicated on Drawings.

C. Steps: 12-inch-wide, 16 inches on center vertically, set into manhole, or as otherwise indicated on Drawings.

2.7 DAMPPROOFING

A. The dampproofing shall be Hydrocide 648 by Sonneborn Building Products, Dehydratine by A.C. Horn, Inc., Meadows Trowel Mastic, or approved equal.

2.8 CONFIGURATION

A. Shaft Construction: Concentric with eccentric cone top section; lipped male/female joints; sleeved to receive pipe sections.

B. Shape: Cylindrical.

C. Clear Inside Dimensions: 48 inches, or as otherwise indicated on Drawings.

D. Design Depth: As indicated on Drawings.

E. Clear Cover Opening: 24-inch diameter, or as otherwise indicated on Drawings.

F. Steps: 12-inch-wide, 16 inches on center vertically, set into manhole, or as otherwise indicated on Drawings.

2.9 BEDDING MATERIALS

A. Bedding and Cover: 3/4-inch Crushed Stone in accordance with Section M.01.09 of the RIDOT Standard Specifications.

B. Soil Backfill from Around Manhole: In pavement areas where controlled density fill is not specified, provide Ordinary Fill to the sub-base of the pavement, and then provide the required sub-base material for the pavement section. In grassed areas where controlled density fill is not specified, provide Ordinary Fill to a point 6 inches below finished grade, then Manufactured Topsoil to finished grade.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify items provided by other sections of Work are properly sized and located.

B. Verify built-in items are in proper location, and ready for roughing into Work.

C. Verify correct size of manhole excavation.

3. 2 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.

C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3. 3 INSTALLATION

A. Excavation and Backfill:
   1. Excavate for manholes to location and depth shown in accordance with Section 31 00 00 – EARTH MOVING and as otherwise specified herein. Provide clearance around sidewalls of structure for construction operations.
   2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes in dry trench.
   3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.

B. Place base pad, trowel top surface level.

C. Install manholes supported at proper grade and alignment on crushed stone bedding as shown on Drawings.

D. Backfill and compact excavations for manholes in accordance with Section 31 00 00 – EARTH MOVING.

E. Form and place manhole cylinder plumb and level, to correct dimensions and elevations.

F. Cut and fit for sleeves.

G. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour to form continuous drainage channel, as indicated on Drawings.

H. Set cover frames and covers level without tipping, to correct elevations.

I. Coordinate with other sections of Work to provide correct size, shape, and location.

3.4 PRECAST CONCRETE INSTALLATION

A. Lift precast components at lifting points designated by manufacturer.

B. When lowering precast structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.

C. Set precast structures bearing firmly and fully on crushed stone bedding, compacted in accordance with State of Rhode Island specifications.

D. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.

E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.

F. Joint sealing materials may be installed on site or at manufacturer’s plant.

G. Verify installations satisfy required alignment and grade.

H. Cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with mortar.

I. Cut pipe to finish flush with interior of structure.

J. Shape inverts through manhole as shown on Drawings.

3.5 FRAME AND COVER INSTALLATION

A. Set frames using mortar and masonry. Install radially laid sewer brick with 1/4-inch-thick vertical joints at inside perimeter. Lay sewer brick in full bed of mortar and completely fill joints. Where more than one course of sewer brick is required, stagger vertical joints. No more than three courses of sewer brick shall be permitted.

B. Set frame and cover 2 inches above finished grade for manholes with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.

3.6 FIELD QUALITY CONTROL

A. Sections 01 40 00 - QUALITY REQUIREMENTS, 016000 - PRODUCT REQUIREMENTS and 01 77 00 - CLOSEOUT PROCEDURES.

B. Vertical Adjustment of Existing Manholes:
1. Where required, adjust top elevation of existing manholes to finished grades shown on Drawings.
2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.
3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated Drawings.

3.7 LEAKAGE TESTS

A. Leakage tests shall be made and observed by the Engineer on each manhole. The test shall be as described below:

B. Vacuum Test (required on all new manholes):
1. The test shall be made using an inflatable compression band, vacuum pump, and appurtenances specifically designed for testing manholes. Test procedures shall be in accordance with the equipment manufacturer’s recommendations. Contactor shall be fully familiar with the vacuum testing equipment and provide a minimum of four hours of instruction by a factory authorized representative at the outset of the project.
2. Each manhole shall be test immediately after assembly including the connection of pipes and prior to backfilling.
3. All lift holes shall be plugged with non-shrink grout and all pipes entering the manhole shall be plugged and braced to prevent the plug from being drawn into the manhole.

4. After test equipment is in place the test shall be run at the following rate and test times:
   a. For 4-foot diameter manholes:
      1) Initial test pressure – 10 inches Hg
      2) Test Time – 1-inch Hg drop to 9 inches Hg in one minute allowable for 0 feet to 10 feet deep manholes.
   b. If the pressure drop exceeds 1-inch Hg in the specified time the manhole shall be repaired in accordance with approved procedures and retested.
   c. If a manhole fails to meet a 1-inch Hg drop in the specified time after repairs the unit shall be water exfiltration tested as specified below and repaired, as necessary.

C. Exfiltration Test (required as described above):
1. Assemble manhole in place; fill and point all lifting holes and exterior joints within 6 feet of the ground surface with an approved non-shrinking mortar. Test prior to placing the shelf and invert before filling and pointing the horizontal joints below 6 feet of depth. Lower groundwater table below bottom of manhole for the duration of the test. Plug all pipes and other openings into the manhole and brace to prevent blowout.
2. Fill manhole with water to the top of the cone section. If the excavation has not been backfilled and no water in observed moving down the surface of the manhole, the manhole is satisfactorily watertight. If the test, as described above is unsatisfactory to the Engineer, or if the manhole excavation has been backfilled, continue the test. A period of time may be permitted to allow for absorption. Following this period, refill manhole to the top of the cone, if necessary, and allow at least eight hours to pass. At the end of the test period, refill the manhole to the top of the cone again, measuring the volume of water added. Extrapolate the refill amount to a 24-hour leakage rate. If the manhole fails this requirement, but the leakage does not exceed three gallons per vertical foot per day, repairs by approved methods may be as directed by the Engineer. If leakage due to a defective joint exceeds this amount, the manhole shall be rejected. Uncover the rejected manhole as necessary to disassemble, reconstruct, or replace it as directed by the Engineer. Retest the manhole, and if satisfactory, fill and point the interior joints.
3. No adjustment in the leakage allowance may be made for unknown causes such as leaking plugs, absorptions, or other. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the entrance.
4. An infiltration test may not be substituted for an exfiltration test if the groundwater table is above the highest joint in the manhole. If there is no leakage into the manhole as determined by the Engineer, the manhole will be considered watertight. If the Engineer is not satisfied, testing shall be performed as described herein.

3.8 CLEANING

A. All new manholes shall be thoroughly cleaned of all silt, debris, and foreign matter of any kind, prior to final inspection.

END OF SECTION 330513

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SECTION 331000 - WATER UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

B. The General Contractor shall either perform the work of this section with its own forces or shall subcontract such work to a subcontractor who will furnish a performance and payment bond for the complete scope of work and listing the Owner as the co-oblige. Such bond shall be procured from a surety that is currently licensed to do business in Rhode Island and is currently listed on the United States Treasure Department circular 570. A copy of such bond shall be submitted to the Owner's Project Manager for approval and shall be in place prior to the subcontractor commencing any work on the project.

1.2 SUMMARY

A. Section Includes:
1. Pipe and fittings for site water line including water mains and laterals.
2. Valves.
3. Backflow preventers.
4. Underground pipe markers.
5. Bedding and cover materials.

B. Related Sections:
1. Section 31 00 00 - EARTH MOVING.
2. Section 32 12 16 - ASPHALT PAVING.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10 lb. Rammer and an 18 in. Drop.

B. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

C. American Society of Sanitary Engineering:

1. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent.
2. ASSE 1013 - Reduced Pressure Principle Backflow Preventers.

D. ASTM International:
1. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
2. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.
3. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3).
5. ASTM D1785 - Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
6. ASTM D2241 - Standard Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).
7. ASTM D2466 - Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
8. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings.
9. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
10. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
11. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

E. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

F. American Water Works Association:
1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C111 - American National Standard for Rubber-Gasket
4. Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
6. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
7. AWWA C502 - Dry-Barrel Fire Hydrants.
8. AWWA C504 - Rubber-Sealed Butterfly Valves.
9. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 in. (50 mm) Through 24in. (600 mm) NPS.
10. AWWA C509 - Resilient-Seated Gate Valves for Water-Supply Service.
11. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
12. AWWA C606 - Grooved and Shouldered Joints.
13. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
14. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
15. AWWA C702 - Cold-Water Meters - Compound Type.
16. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
17. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution.
18. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. through 3 in., for Water Service.

19. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

G. Underwriters Laboratories Inc.:
1. UL 246 - Hydrants for Fire - Protection Service.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on pipe materials, pipe fittings, valves, hydrants, and accessories.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 77 00 - CLOSEOUT PROCEDURES.

B. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with RIDOT and RI DEM standards, including the potable water supply construction permit issued for this project.

B. Maintain one copy of each document on site.

C. Valves: Manufacturer's name and pressure rating marked on valve body.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - PRODUCT REQUIREMENTS: Requirements for transporting, handling, storing, and protecting products.

B. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 WATER PIPING

A. Pipe shall be ductile iron push on joint pipe manufactured in accordance with the requirements of ANSI/AWWA C151/A21.51 and shall be thickness Class 52 with a minimal wall thickness of 0.31 inch for 6 inch pipe, 0.33 inch for 8 inch pipe, 0.35 inch for 10 inch pipe, and 0.37 inch

for 12 inch pipe. Pipe thickness shall be designated in accordance with ANSI/AWWA C150/A21.50 and shall be based on laying connections and internal pressure as specified in the project plans. The rated working pressure shall be a minimum of 350 psi. Push on joints for such pipe shall be in accordance with ANSI A21.11/AWWA C111. Only in special circumstances will mechanical joints be allowed with the prior approval of the Engineer. Pipe shall have cement mortar lining twice the normal thickness and tar coating in accordance with ANSI A21.4-90/AWWA C104. Pipe lengths shall be standard 18 feet or 20 feet unless otherwise approved. Bell joint end shall have a rubber gasket to assure a permanent seal. The spigot end shall have a slight bevel for easy passage through gasket.

B. Ductile iron water pipe shall be installed in a flat bottom trench, backfilled lightly with a selected material removed in excavation with nothing larger than 2 inches in diameter. This material will be consolidated to centerline of pipe; after this is done the same materials will be used to provide a 12-inch cover over the top of the installed main.

C. Ductile iron water pipe shall not be laid with a deflection of more than 12 inches.

2.2 SERVICE BOXES

A. Plug cover to be in cement or asphalt, the word ‘WATER’ shall be cast into the cover, the box will be of a length in height to accommodate any bury depth with 1-foot adjustment height. The overall height is to be 4-1/2 to 5-1/2 feet unless otherwise approved by the engineer. The service box will be reinforced at arch and pipe ring area and will accommodate up to a 1-inch curb stop. Service box rod will have a heavy ductile iron yoke with a brass copper pin. Service boxes shall be identical to present City of Providence Water Department requirements.

2.3 VALVE BOXES

A. Valve boxes shall be cast iron, tar coated, two piece adjustable sliding type with a top flange and a minimum inside shaft diameter of 5-1/4 inches. Boxes shall have the word ‘WATER’ clearly cast into the cover. Bell end of the lower sections shall in all cases be sufficiently large enough to fit over the stuffing boxes of the valves. Valve boxes shall be buried 5 feet or deeper to accommodate installation and have a minimum of 12 inch overlap so there is 1 foot adjustment. A positive centering cap made of high strength plastics should be placed over the valve onto which the valve box will be centered. Valve boxes shall be identical to present City of Providence Water Department requirements.

2.4 GATE VALVES

A. Manufacturers: Shall be the double disc or resilient wedge style gate valves as manufactured by Mueller with mechanical joints designed for a test pressure of 200 psi. Gate boxes shall be identical to present City of Providence Water Department requirements.

B. 2-1/2 inch and Smaller: Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, extension box and valve key. Open right. Epoxy coated.

C. 3 inch and Larger: AWWA C500, Iron body, bronze trim, non-rising stem with square nut, single wedge, flanged ends, control rod, extension box and valve key. Open right. Epoxy coated.

2.5 BACKFLOW PREVENTERS

A. Manufacturers: Any manufacturer whose product meets the requirements of the specifications, and the requirements of the City of Providence Water Department, shall be considered.

B. Furnish materials in accordance with RIDOT and RI DEM standards.

C. Reduced Pressure Backflow Preventers:
1. Comply with ASSE 1013.
2. Bronze body, with bronze internal parts and stainless-steel springs.
3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

D. Double Check Valve Assemblies: Comply with ASSE 1012; Bronze body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves with intermediate atmospheric vent.

2.6 UNDERGROUND PIPE MARKERS

A. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Water Service" in large letters.

2.7 BEDDING AND COVER MATERIALS

A. Bedding: 1-1/2-inch stone in accordance with Section M.01.04 of the RIDOT Standards.

B. Cover: 3/4-inch Crushed Stone in accordance with Section M.01.09 of the RIDOT Standards.

C. Soil Backfill from Above Pipe to Finish Grade: Ordinary Fill as specified in Section 31 00 00 – EARTH MOVING.

D. Bituminous Asphalt Patch: Refer to patching requirements under Section 32 12 16 - ASPHALT PAVING.

2.8 JOINT RESTRAINT PRODUCTS

A. Wedge Action Retaining Joints may be used wherever approved by the City of Providence and shall be manufactured of ductile iron conforming to ASTM A536. The mechanical joint restraint shall be Megalug Series 1100 or equal approved by DPW.

B. Concrete for Thrust Blocks: 4,000 psi concrete in accordance with Section M.02.01.1 of the RIDOT Standards.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify building service connection and municipal utility water main size, location, and invert are as indicated on Drawings.

3.2 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.

3.3 BEDDING

A. Excavate pipe trench in accordance with Section 31 00 00 – EARTH MOVING for Work of this Section.

B. Form and place concrete for pipe thrust restraints at change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide square footage of thrust restraint bearing on subsoil per detail.

C. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8-inch compacted depth; compact to 95 percent.

D. Backfill around sides and to top of pipe in accordance with Section 31 00 00 – EARTH MOVING.

F. Maintain optimum moisture content of fill material to attain required compaction density.

G. Place fill materials in accordance with Section 31 00 00 – EARTH MOVING and Section 32 12 16 - ASPHALT PAVING.

3.4 INSTALLATION - PIPE

A. Maintain 10-foot horizontal separation of water piping from sewer piping unless site constraints prohibit.

B. Install pipe to indicated elevation to within tolerance of 5/8 inch.

C. Route pipe in straight line.

D. Install pipe to allow for expansion and contraction without stressing pipe or joints.

E. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.

F. Establish elevations of buried piping with not less than 5.5 feet of cover. If cover is less than 5.5 feet, the pipe shall be insulated with 2 inches of extruded polystyrene insulation. The pipe shall maintain a minimum of 4 feet of cover.

G. Install trace wire continuous over top of pipe.

H. Backfill trench in accordance with Section 31 00 00.

I. Install Work in accordance with RIDOT and RI DEM standards.

3.5 UNDERGROUND PIPE MARKERS

A. Manufacturers:
   1. Any manufacturers of such products shall be considered.
   2. Substitutions: Refer to Section 01 60 00 - PRODUCT REQUIREMENTS.

B. Plastic Ribbon Tape: Bright colored, imprinted with "WATER” in large letters, minimum 6 inches wide by 4 mil. thick, manufactured for direct burial service.

C. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "WATER SERVICE” in large letters.

3.6 INSTALLATION - VALVES

A. Set valves on compacted soil.

B. Center and plumb valve box over valve. Set box cover flush with finished grade.

C. Install Work in accordance with RIDOT and RI DEM standards.

3.7 SERVICE CONNECTIONS

A. Install water service in accordance with double check valve backflow preventer.

B. Install water service to the building. Connect to building water service.

C. Install Work in accordance with Rhode Island State Plumbing Code.

3.8 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. CLOSEOUT SUBMITTALS
1. Section 01 77 00 - Closeout Procedures
2. DISINFECTION REPORT:
   a. Type and form of disinfectant used.
   b. Date and time of disinfectant injection start and time of completion.
   c. Test locations.
   d. Name of person collecting samples.
   e. Initial and 24-hour disinfectant residuals in treated water in ppm for each outlet tested.
   f. Date and time of flushing start and completion. Disinfectant residual after flushing in ppm for each outlet tested.
3. Bacteriological REPORT:
   a. Date issued, project name, and testing laboratory name, address, and telephone number.
   b. Time and date of water sample collection.
   c. Name of person collecting samples.
   d. Test locations.
   e. Initial and 24-hour disinfectant residuals in ppm. for each outlet tested.
   f. Coliform bacteria test results for each outlet tested.
   g. Certify water conforms, or fails to conform, to bacterial standards of RI DEM standards for drinking water.
   h. Water Quality Certificate: Certify water conforms to quality standards of RI DEM, suitable for human consumption.
4. QUALITY ASSURANCE
   a. Perform Work in accordance with AWWA C651 (equivalent to State standards).
   b. Maintain one copy of each document on site.
5. QUALIFICATIONS
   a. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this section with minimum three years documented experience.
   b. Testing Firm: Company specializing in testing and examining potable water systems, approved by State of Rhode Island.
   c. Submit bacteriologist's signature and authority associated with testing.
6. DISINFECTION CHEMICALS
   a. Chemicals: Chlorine solution used for disinfecting springs, wells, and other water systems shall consist of a solution of water and liquid chlorine, sodium hypochlorite, calcium hypochlorite, or chloride of lime.
   b. Liquid forms of chlorine or sodium hypochlorite and powder forms of calcium hypochlorite or chloride of lime shall be used according to the instructions supplied by the manufacturer and as recommended by the Rhode Island Department of Health.
   c. If sodium hypochlorite is already in solution as a laundry bleach containing 5.25% sodium hypochlorite, it shall be used at the rate of one part per 12,000 parts of water to be disinfected. The dosage should be sufficient to produce a chlorine taste in the water.
7. EXAMINATION
   a. Verify existing conditions before starting work.

b. Verify piping system has been cleaned, inspected, and pressure tested.
c. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting, and balancing, demonstration procedures, including coordination with related systems.

8. INSTALLATION
   a. Provide and attach required equipment to perform the Work of this section.
   b. Perform disinfection of water distribution system and installation of system and pressure testing.
   c. Introduce treatment into piping system at a concentration of 50 mg Cl/L.
   d. Maintain disinfectant in system for 24 hours.
   e. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.
   f. Replace permanent system devices removed for disinfection.
9. Disinfection, FLUSHING, AND SAMPLING:
   a. Disinfect pipeline installation in accordance with AWWA C651. Use of liquid chlorine is not permitted.
   b. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that generally prevailing in existing system or is acceptable for domestic use.
   c. Legally dispose of chlorinated water. When chlorinated discharge may cause damage to environment, apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.
   d. After final flushing and before pipeline is connected to existing system, or placed in service, employ an approved independent testing laboratory to sample, test and certify water quality suitable for human consumption.

3.9 FIELD QUALITY CONTROL

A. Sections 01 40 00 - QUALITY REQUIREMENTS and 01 77 00 - CLOSEOUT PROCEDURES.

B. Pressure test system. Repair leaks and re-test.
   1. After completion of pipeline installation, including backfill, but prior to final connection to existing system, conduct, in presence of Architect/Engineer, concurrent hydrostatic pressure and leakage tests in accordance with AWWA C600.
   2. Provide equipment required to perform leakage and hydrostatic pressure tests.
   3. Test Pressure: Not less than 200 psi or 50 psi in excess of maximum static pressure, whichever is greater.
   4. Conduct hydrostatic test for at least two-hour duration. Submit FM Global certificate for underground leak pressure test to CM.
   5. No pipeline installation will be approved when pressure varies by more than 5 psi at completion of hydrostatic pressure test.
   6. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, close corporation cocks and apply test pressure. At conclusion of tests, remove corporation cocks removed and plug resulting piping openings.
   7. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.

8. Examine exposed piping, fittings, valves, hydrants, and joints carefully during hydrostatic pressure test. Repair or replace damage or defective pipe, fittings, valves, hydrants, or joints discovered, following pressure test.
9. When leakage is detected, locate source, and make repairs. Repeat test until specified leakage requirements are met.

C. Compaction Testing for Bedding: In accordance with ASTM D1557.

D. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

E. Frequency of Compaction Tests: As directed by Engineer.

END OF SECTION 331000

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

B. The General Contractor shall either perform the work of this section with its own forces or shall subcontract such work to a subcontractor who will furnish a performance and payment bond for the complete scope of work and listing the Owner as the co-oblige. Such bond shall be procured from a surety that is currently licensed to do business in Rhode Island and is currently listed on the United States Treasure Department circular 570. A copy of such bond shall be submitted to the Owner's Project Manager for approval and shall be in place prior to the subcontractor commencing any work on the project.

1.2 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to install high density polyethylene pipe, fittings and appurtenances as indicated and as specified herein.

1.3 RELATED WORK

A. Section 31 00 00 - EARTH MOVING

B. Section 33 05 13 - MANHOLES AND STRUCTURES

1.4 SUBMITTALS

A. Submit the name of the pipe and fitting suppliers and Shop Drawings, showing layout details of reinforcement, joint, method of manufacture, and installation of pipe, specials, and fittings for the entire job.

B. Prior to each shipment of pipe submit certified test reports and a notarized affidavit stating that all pipe meets requirements of ASTM D1238 & ASTM D1505.

1.5 REFERENCED STANDARDS

A. American Society for Testing and Materials (ASTM):
1. ASTM D1238 - Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
2. ASTM D1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

3. ASTM D1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique.
4. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
5. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
6. ASTM D3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Materials
7. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe and (SDR-PR) Based on Outside Diameter.
8. ASTM C507 - Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe

B. Where reference is made to one of the above standards, the revision in effect at the time of the bid opening shall apply.

PART 2 - PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

A. High Density Polyethylene (HDPE) Pipe resins shall be high molecular weight, high density polyethylene with a cell classification number of 424420C in accordance with ASTM D3350.

B. HDPE shall have a smooth interior and annular exterior corrugations, 12 inch through 60-inch piping shall meet ASTM F2648 and shall be either AASHTO Type ‘S’ or Type ‘D’.

C. Pipe shall be joined using a bell & spigot joint meeting ASTM F2648. The joint shall be soil-tight and gaskets, when applicable, shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable wrap to ensure the gasket is free from debris. A joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly.

D. Pipe shall support an HS-20 live load with a maximum deflection of 5% of the minimum pipe diameter.

E. Pipe shall be furnished in standard laying lengths not exceeding 25 feet.

F. All single pipe high density polyethylene pipe and fittings shall be made from the same resin.

G. Pipe shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252 and M294.

2.2 POLYVINYL CHLORIDE (PVC):

A. Pipe and Fittings, Type PSM PVC Pipe, shall conform to ASTM D3034, Type PSM, SDR 35. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D 3212. Gaskets shall conform to ASTM F 477. Solvent welded joints shall not be permitted.

2.3 UNDERGROUND PIPE MARKERS

A. Manufacturers:

1. Any manufacturers of such products shall be considered.
2. Substitutions: Refer to Section 01 60 00 - PRODUCT REQUIREMENTS.

B. Plastic Ribbon Tape: Bright colored, imprinted with "Storm Drain Line" in large letters, minimum 6 inches wide by 4 mil. thick, manufactured for direct burial service.

2.4 GEOTEXTILE

A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.5 PIPE IDENTIFICATION

A. The following shall be continuously indent printed on the pipe and spaced at intervals not exceeding 5 feet.

1. Name and/or trademark of the pipe manufacturer.
2. Nominal pipe size.
3. Dimension ratio.
4. The letters PE followed by the polyethylene grade in accordance with ASTM D1248, followed by the hydrostatic design basis in 100’s of psi., e.g., PE 3408.
5. Manufacturing standard reference, e.g., ASTM F714.
6. A production code from which the date and place of manufacture can be determined.

PART 3 - EXECUTION

3.1 INSTALLATION - PIPE

A. High Density Polyethylene (HDPE) Pipe shall be installed in accordance with the instruction of the manufacturer, as indicated and as specified herein.

B. Polyvinyl Chloride (PVC) Pipe shall be installed in accordance with the instruction of the manufacturer, as indicated and as specified herein.

C. Pipe shall be laid to lines and grade as indicated with bedding and backfill as indicated.

D. When laying is not in progress, the open ends of the pipe shall be closed by fabricated plugs, or by other approved means. All plugs shall be OD fitting type plugs. No plugs will be allowed that require insertion of the plug into the pipe.

E. Pipe shall be stored on clean level ground to prevent scratching or gouging. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. The maximum allowable depth of cuts, scratches, or gouges on the exterior of the pipe is 10 percent of the wall thickness. The interior pipe surface shall be free of cuts, gouges, or scratches.

F. Sections of pipe with cuts, scratches, or gouges deeper than allowed shall be removed completely and replaced and the ends of the pipeline rejoined at no additional cost to the Owner.

G. Single pipe systems shall be jointed by the method of thermal butt fusion, as outlined in ASTM D2657. All joints shall be made in strict compliance with the manufacturer's recommendations.

H. All HDPE pipe must be at the temperature of the surrounding soil at the time of backfilling and compaction.

3.2 TESTING

A. HDPE storm drain pipe installations shall be mandrel tested to ensure that the pipe has maintained a circular shape in cross section throughout installation. The pipe shall remain within 5% of a true circular shape. Pipe deflection beyond 5% shall be repaired by reinstallation.

3.3 CLEAN UP

A. Prior to Final Completion of the Work, thoroughly clean all the new pipelines and remove all dirt, stones, and pieces of wood or other materials.

END OF SECTION 334100